Air Pollution Aspects of Emission Sources

BOILERS

A Bibliography with Abstracts

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AIR POLLUTION ASPECTS
OF EMISSION SOURCES:
BOILERS—
A BIBLIOGRAPHY WITH ABSTRACTS

Air Pollution Technical Information Center

ENVIRONMENTAL PROTECTION AGENCY
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AIR POLLUTION ASPECTS
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INTRODUCTION

Boilers contribute significantly to the overall air pollution level in the United States. To aid efforts to improve air quality, the Air Pollution Technical Information Center (APTIC) of the Office of Air Programs has compiled this bibliography relevant to the problem and its solution.

Approximately 490 abstracts have been selectively screened from the contents of APTIC's information storage and retrieval system to cover the 14 categories set forth in the table of contents. The compilation is intended to be representative of available literature, and no claim is made to all-inclusiveness.

Subject and author indexes refer to the abstracts by category letter and APTIC accession number. Generally, higher accession numbers, representing the latest acquisitions, cover the most recent material.

All documents abstracted herein are currently on file at the Air Pollution Technical Information Center, Office of Air Programs, Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Readers outside the Environmental Protection Agency may seek duplicates of documents directly from libraries, publishers, or authors.

A. EMISSION SOURCES

01788

R.P. Hangebrauck, D.J. Von Lehmden, J.E. Meeker

EMISSIONS OF POLYNUCLEAR HYDROCARBONS AND POLLUTANTS FROM HEAT-GENERATION AND INCINERATION PROCESSES. J. Air Pollution Control Assoc. 14, (7) 267-78, July 1964. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 11, 1963.)

This paper presents emission data from a series of tests, for which the sources tested included typical combustion processes involving the burning of conventional fuels (coal, oil, and gas) and of certain commercial and municipal solid wastes. In addition to obtaining over-all emission data from different sizes and types of combustion units, a primary objective of the study was to establish the relative importance of various combustion processes as contributors of benzo(a)pyrene (3,4 benzpyrene) and other polynuclear hydrocarbons with demonstrated or potential carcinogenic properties. The other pollutants measured included particulate matter, carbon monoxide, total gaseous hydrocarbons, oxides of nitrogen, oxides of sulfur, and formaldehyde. Two categories of combustion sources were tested. Those burning conventional fuels were designated as heat-generation processes, and those burning waste materials were classed as incineration processes. Design and operation data for the units studied are given in tables.

02148

T. Taga

(NO2 GAS GENERATED IN THE COMBUSTION CHAMBER OF COAL BURNING BOILERS.) Clean Air Heat Management (Tokyo) 15 (4), 5-9 (Apr. 1966). Jap. (Translated as JPRS-R-8588-D.)

The author emphasizes the importance of NO2 in air pollution and urges that as much effort should be exerted in abating pollution due to this gas as to SO2 or SO3 which are currently under extensive study. The paper describes the experimental study done by the U.S. Bureau of Mines, and discusses the results of a similar study by the author.

02287

F. Glaubitz

THE ECONOMIC COMBUSTION OF SULFUR-CONTAINING HEATING OIL. (A MEANS OF AVOIDING DEW POINT DIFFICULTIES IN BOILER OPERATION). Combustion 31-5, Jan. 1963. (Presented at the Meeting of the Work Group 'Oil Furnaces', VGB, Graz, Austria, May 2, 1960.)

In order to control corrosion by avoiding dew point difficulties in a boiler fueled with oil, the burners were redesigned and fuel meters were installed. Low excess air and flue gas oxygen content were then attainable. Measurements are reported.

02629

Wagner, R. J.

FIRESIDE DEPOSITS IN LIGNITE-FIRED BOILERS. In: Technology and Use of Lignite. Proceedings: Bureau of Mines-University of North Dakota Symposium, Bismarck, N. Dak., April 29-30, 1965. James L. Elder and Wayne R. Kube (compilers), Bureau of Mines, Washington, D. C., IC-8304, p. 20-27, 1966.

Fire side deposits in lignite fired boilers are discussed with emphasis on these deposits as they relate to cost ((initial, availability, performance)), the nature of the deposits, and methods of control. With fireside deposits in lignite-fired boilers special design features are needed. These features will increase the initial cost of a lignite-fired boiler approximately 25 to 50 percent over that of a boiler of similar capacity using a high-rank coal. Fireside deposits are a major cause of unavailable time in lignite-fired boilers. Of the 8.6 percent unavailable time, in a power plant 19.5 percent was directly associated with fireside deposits in the boilers. This 'unavailable' time was spent in cleaning out a fouled boiler. Boiler performance depends on soot blowing. Additional soot blowers are needed in a lignite-fired boiler. These extra blowers are a double expense to operations in that more steam is used and maintenance costs are increased. The fireside deposits occurring in a lignite-fired boiler vary greatly in appearance, in physical and mechanical structure, and in chemical composition from one boiler to another and from day to day in the same boiler. A mineralogical analysis shows that the bulk of the deposit is calcium sulfate. Proper combustion in the furnace should be the first consideration for reduction of fireside deposits. The correct fuel-to-air ratio must be maintained and good mixing during combustion should be achieved. Correct location of an adequate number of soot blowers is the second consideration in holding down gas temperatures and, consequently, deposition. Cleanup is accomplished in three ways: (1) dry removal of the deposits with bars and hammers (sometimes pneumatic equipment is used); (2) water washing of the deposit; and (3) sandblasting of stubborn deposits. All method are successful to varying degrees, but each unit requires different handling.

02630

Duzy, A. F., and J. B. Walker, Jr.

UTILIZATION OF SOLID FUEL HAVING LIGNITE TYPE ASH. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines, North Dakota Univ. Symposium, Bismark, Apr. 29-30, 1965). (Information Circular No. 8304). p. 27-39, 1966.

The impurities in low-rank coals are considered. Although low-rank coals have a high volatile matter content and a low ignition temperature and are relatively easy to burn, their impurities may be quite variable or troublesome in boiler design and operation. Included are sections on types of ash; lignite-type-ash fuels; mining and preparation of lignite-type-ash coals; ash fusibility; fouling and slagging characteristics; abrasiveness and erosiveness of raw coal; upgrading coal; and standards required.

02631

Sondreal, E. A., W. R. Kube, and J. L. Elder

CHARACTERISTICS AND VARIABILITY OF LIGNITE ASH FROM THE NORTHERN GREAT PLAINS PROVINCE. (In: Proceedings on Technology and Use of Lignite). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines-North Dakota Univ. Symposium, Bismark, Apr. 29-30, 1965.) (Information Circular No. 8304). p. 39-50, 1966.

The aim was to present current results of the Bureau of Mines investigation of lignite ash at Grand Forks Coal Research Laboratory. The program is described. Included are sections on the survey of ash characteristics; lignite sampling for the ash survey; analytical procedures, composition of coal ash; critical properties of lignite ash; behavior of sulfur in lignite; and trace elements in lignite ash.

02634

Scott, D.

UTILIZATION OF LOW-RANK FOSSIL FUEL: REPORT OF SUBSECTION COMMITTEE OF THE CANADIAN ELECTRIC ASSOCIATION (IN: PROCEEDINGS ON TECHNOLOGY AND USE OF LIGNITE). Bureau of Mines, Pittsburgh, Pa. (Presented at the Bureau of Mines- North Dakota Univ. Symposium, Bismarck, Apr. 29-30, 1965.) Information Circular No. 8304) p. 89-99, 1966.

A questionnaire was prepared and circulated to major coal users, including utilities in the Northern United States, where considerable research and development is being done on coal burning and associated work with low-rank fuels. Most users have run and are running into difficulties (of one form or another) due in general to the equipment not being complete enought in its design to cope with the special characteristics of the fuel used and nature of the environment. The problem areas are sectionalized, with emphasis on the most prominent problem, that of boiler fouling. Sections are included on fuel handling and storage; stoker firing; pulverized firing; slag-tap firing; fouling of furnaces; ash handling; contrifugal mechanical dust collectors; ash and dust removal; and instrumentation and controls.

02667

W. Thieme

EMISSION MEASUREMENTS OF HEAVY-DUTY BOILERS FOR SOLID FUELS. STAUB (ENGLISH TRANSLATION) 25, (6) 14-20, JUNE 1965. CFSTI TT 66-51040/6

Emission measurements carried out on heavy-duty boilers for solid fuel are discussed. After a description of dust measuring methods and of test conditions, the boiler design and the mode of operation during the tests are considered. The results show that the dust emission is a function of boiler load, and that it increases with increasing output. The emitted dust mainly consisted of fly ash and small amounts of coke. Measurements with the Bacharach instrument have been unsuccessful. The dust emission in the case of automatic boilers never exceeds a value of 0.5 kg/hr. (Author summary)

03154

N. E. Flynn and W. R. Crouse

REPORT ON NITROGEN OXIDES IN THE BAY AREA AIR POLLUTION CONTROL DISTRICT. Preprint. 1964.

Total oxides of nitrogen (NOx) emissions in the Bay Area Air Pollution Control District for 1963 are estimated at 515 tons/day. A summation of emissions of oxides of nitrogen by general source categories is presented. Transportation at 323 tons/day is the major source category of nitrogen oxides emissions and accounts for 63% of all oxides of nitrogen emissions for the Bay Area. Combustion operations at 150 tons/day are the second largest source category and contribute 29% of the nitrogen oxides emissions. Emissions from small, medium, and large stationary sources with incinerations, agriculture, and transpotation sources grouped separately, are presented. (Author summary modified)

03870

C. A. Hescheles

INDUSTRIAL WASTE ANALYSIS AND BOILER PERFORMANCE TEST BURNING WASTES. Preprint. (Presented at the Winter Annual Meeting and Energy Systems Exposition, American Society of Mechanical Engineers, New York City, Nov. 27-Dec. 1, 1966.)

Detailed analyses are presented of industrical process wastes from the normal manufacturing process in the rubber goods industry. Test results are presented from a boiler burning industrial process wastes, manually batch fed to a reciprocating stoker. The boiler is equipped with a water- cooled furnace specially designed for high furnace temperatures. (Author abstract modified)

04082

F. F. Lampert

PREVENTION OF AIR POLLUTION IN GAS EQUIPPED APARTMENTS (WITH REFERENCE TO THE PROPOSED SANITARY REGULATIONS FOR GAS EQUIPPED RESIDENCES). Gigiena i Sanit. 28, (4) 60-2, Apr. 1963. Russ. (Tr.) (Transkated by B. S. Levine in U. S. S. R. Literature on Air Pollution and Related Occupational R. Literature on Air Pollution and Related Occupational Diseases, Vol. 12.)

Gas is gradually replacing hard fuel in the USSR, which affects favorably the population's living conditions. Lack of development or improvement in gas burners has resulted in frequent air pollution in houses and apartments which have been equipped with gas. Gas burning generates such air polluting products as carbon monoxide, carbonic acid, hydrocarbons, etc; it also raises the surrounding air temperature and humidity, easily detected even after the gas has been used for 1 hour. Comparative studies conducted in differently planned gas-equipped living quarters indicated that where living rooms were connected directly with the kitchen, intensity of air pollution with carbon monoxide and other products of gas combustion, was greater than in apartments in which kitchen was isolated from the living room. These facts clearly point to the channels along which modern engineers, planners, architects, and hygienists must direct their attention for the rational solution of the air pollution problem in future construction of gas equipped residential houses and apartments. Therefore, it is urged that construction and planning engineers in sanitary organizations should make proper use of the available home gas equipment. It is also suggested that for the purposes of proper sanitary safety gas burning utilities, particularly those used for water heating, should be equipped with automatic safety devices which would stop the gas flow as soon as unfavorable conditions developed in the exhaust flue.

04342

R. C. Attig and P. Sedor

A PILOT-PLANT INVESTIGATION OF FACTORS AFFECTING LOW-TEMPERATURE CORROSIONS IN OIL-FIRED BOILERS. Proc. Am. Power Conf. (Presented at the 26th Annual Meeting, American Power Conference, Chicago, Ill., Apr. 14-16, 1964.) 26, 553-66, Apr. 1964.

The aim was to find methods of controlling or eliminating corrosion. Tests were run on a pilot unit to study the effect of metal temperature, sulfur content of the fuel oil, excess air, flue gas recirculation, and two-stage combustion on (1) low-temperature corrosion rates at various metal temperatures below the acid dewpoint, and (2) sulfur trioxide formation. The constant-temperature probe is the best method of integrating the many factors affecting low-temperature corrosion. Operating at very low excess air while firing a high-sulfur oil produces sulfuric acid corrosion rates comparable to those obtained when firing a low-sulfur distillate oil or natural gas. Also, a major factor affecting the corrosion rate of carbon steel below the acid dewpoint is the surface temperature of the exposed steel, and above the water dewpoint, flue gas recirculation has the potential of reducing the rate of acid attack by at least 30 percent.

04799

L. Alliot, M. Auclair, A. Labardin, F. Mauss, R. Four, and F. Iehle

EMISSION OF SOLID PARTICLES BY COMBUSTION OF FUEL OILS CENTRAL HOT WATER HEATING. Emission de Particules Solides par la Combustion d'huiles Combustibles Fluides (Chauffage Central a Chaude). Rev. Inst. Franc. Petrole Ann. Combust. Liquides (Paris) 20, (11) 1755-92, Nov. 1965. Fr.

In conjunction with its combustion research, and, in particular, research on the emission of solid particles by various heat sour- ces, the Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospheriques (C.I.T.E.P.A.) requested three laboratories to investigate certain parameters relating to the output and operation of liquid fuel boilers. The laboratories were Esso Standard, the Institut Francais du Petrole, and Shell Berre. This article described the different tests and studies which were made. The results provide guidelines for engineering problem relating to the construction and installation of a boiler and its components, and for its good performance. In the case of continuous combustion, an optimal operating value for a boiler unit was observed to coincide with optimal reduction of particulate emission (at about 80% nominal operative power.) Operation exceeding the optimal level caused an increase in particulate emission. On the other hand, reduction from the nominal optimum of operation to one fifth of this resulted in an increase in particulate emission on the order of 60 to 100%. For a given installation, depending on the boiler and burner capacities respectively, there exists an optimal output in regard to emission control.

05005

R. P. Hangebrauck, D. J. von Lehmden, and J. E. Meeker

SOURCES OF POLYNUCLEAR HYDROCARBONS IN THE ATMOSPHERE. Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control. (PHS Publ. No. 999-AP-33.) 1967. 48 pp.

Rates of emissions of polynuclear hydrocarbons were measured at several sources considered likely to produce such emissions. The sources included heat generation by combustion of coal, oil, and gas; refuse burning; industrial processes; and motor vehicles. The annual emissions of benzo(a)pyrene in the United States were estimated for each of the sources surveyed, to provide a rough gauge of the importance of each source. Small, inefficient residential coal-fired furnaces appear to be a prime source of polynuclear hydrocarbons; other sources may be of local importance. Production of polynuclear hydrocarbons was generally associated with conditions of incomplete combustion. (Author abstract)

05011

A. A. Orning, C. H. Schwartz, and J. F. Smith

MINOR PRODUCTS OF COMBUSTION IN LARGE COAL-FIRED STEAM GENERATORS . American Society Mechanical Engineers New York Paper 64- wA/FU-2. (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 29-Dec. 4, 1964 .)

An analysis is given of the minor products of combustion from large coal-fired steam generators in relation to thermodynamic equilibria, unit design and operating conditions. Concentrations of nitrogen oxides and the ratios of sulfur trioxide to total sulfur oxides are near equilibrium values at the furnace outlet. Significant amounts of low molecular weight organic acids and comparatively small amounts of polynuclear aromatic hydrocarbons are found under good combustion conditions. (Author abstract)

05157

Los Angeles County Air Pollution Control District, Calif. (Sept. 1960). 83 pp.

EMISSIONS OF OXIDES OF NITROGEN FROM STATIONARY SOURCES IN LOS ANGELES COUNTY (REPORT 2: OXIDES OF NITROGEN EMITTED BY SMALL SOURCES).

This program was organized to study source groupings classified according to the discharge of oxides of nitrogen per unit of equipment, as follows: (1) large (those emitting over 100 lbs/hr.); (2) medium (those emitting 5 to 100 lbs/hr.); and (3) small (those emitting less than 5 lbs/hr.). This report discusses the evaluation of data obtained from tests made on small sources. It was calculated that the total weight of NO2 and NO emitted into the atmosphere in Los Angeles County from all small stationary sources averages 59 tons/calendar day during the 6 months' heating season (November through April) and 32 tons/ calendar day during the remainder of the year. The weighted average of these amounts is 46 tons/calendar day. Of this weighted average daily discharge of NO2 and NO from all small stationary sources, slightly over half (27 tons) originates from gas-fired commercial and domestic appliances and the remainder (19 tons) from small industrial sources. Most of the NO2 and NO discharged from small industrial sources (approximately 16 tons/calendar day, weighted average) is produced by boilers of less than 500 horsepower rating. Most of the seasonal variations in the total weight of NO2 and NO discharged from small stationary sources are ascribable to the nearly two million residential space heaters, which vent 19 tons/calendar day during the heating season and none during the remainder of the year. A summary of NO2 and NO emissions for all small stationary sources is presented. Investigations of the sampling and analytical techniques employed showed that the chosen procedures and techniques produce reliable analytical results.

05160

J. L. Mills, K. D. Leudtke, P. F. Woolrich, and L. B. Perry

EMISSIONS OF OXIDES OF NITROGEN FROM STATIONARY SOURCES IN LOS ANGELES COUNTY (REPORT 3: OXIDES OF NITROGEN EMITTED BY MEDIUM AND LARGE SOURCES). Los aAngeles County Air Pollution Control District, Calif. (Apr. 1961). 61 pp.

The total weight of oxides of nitrogen discharged into the atmosphere each day in Los Angeles County from stationary sources was determined. The sources are divided into medium and large sources. Medium sources includes those emitting five to one hundred lbs. NOx per hr. and the large sources includes those emitting over 100 lbs. per hr. The total emissions of NOx from all medium sources amounts to 70 tons per day during the winter and 54 tons per day during the summer. The total emissions of NOx from all large sources amounts to 160 tons per day during the winter and 93 tons per day during the summer.

05264

W. L. Spindler

DEVELOPMENT OF A WIDE-RANGE TRIPLE STAGE ATOMIZER FOR RESIDUAL FUEL OIL. Naval Boiler and Turbine Lab., Philadelphia, Pa. (Aug. 18, 1965.) 40 pp.

Triple stage atomizers were developed for naval use in wide range burner application. Todd 4M, B&W Iowa registers and Navy Special Fuel Oil were used during this development. Tests were conducted on a spray and particle analysis test stand and on full scale DLG-6 and DLG-9 Class test boilers. A sprayer plate combination of sufficient capacity was selected for thorough performance testing and comparison, with Todd return flow atomizers. The triple stage atomizers were found unsuitable for use on naval boilers because of (1) lack of good flow continuity throughout the firing range, (2) coking of idle stages, and (3) plugging of sprayer plates. (Author abstract modified)

05387

CONTROL OF INDUSTRIAL BOILERS BY OXYGEN ANALYSIS OF FLUE GASES. Power Works Eng. 61 (723), 57-61 (Sept. 1966).

Oxygen measurement can only be affected by one other gas, nitric oxide, which is not found in the products of combustion of coal or oil. An oxygen analyser is some ten times more sensitive than a CO2 analyser, and much more rapid in response, five to eight seconds as compared with one to five minutes for a CO2 analyser, and the sampling and operation is continuous so that in certain applications oxygen analysis can be used as a basis for automatic control. Most oxygen analysers utilse the paramagnetic property of oxygen; thus, when it comes under the influence of a magnetic field it tends to move to the point of greatest intensity, whereas most other gases are diamagnetic, i.e., they are repelled from a magnetic field. Also the degree of paramagnetism is affected by temperature, cold oxygen being more strongly attracted than hot oxygen. The latter property is utilised in one type of oxygen analyser which operates on the 'magnetic wind' principle. The magnetic wind, hot-wire or filament, and dumb-bell types are reviewed. Sampling methods and applications are discussed. Oxygen measurement is direct and not inferential, and depends on no other factor than the percentage of oxygen present. It is because the sampling system is continuous and the analyser fast in response that in some applications the system is used as a basis for automatic combsution control. In spite of being much more sensitive than a CO2 analyser, the oxygen analyser is robust and little routine skilled maintenance is necessary.

05563

Turner, D. B.

THE DIURNAL AND DAY-TO-DAY VARIATIONS OF FUEL USAGE FOR SPACE HEATING IN ST. LOUIS, MISSOURI. Atmos. Environ., Vol. 2, pp. 339-351, July 1968. ((7)) refs.

Data on the wintertime emission of SO2 residential and commercial spaceheating sources by 2-hour periods were need for use in a diagnostic dispersion model. Analyses were made of hourly gas-sendout data for December 1964 at St. Louis, Mo., to determine dependence upon temperature and other factors. Methods were then developed to determine the rate of fuel use from residential and commercial space-heating sources for each hour of the day from values for the hourly temperature, the hour of the day, and the day of the week. Relations developed from December 1964 data were tested on data for January and February 1965.

05800

R. D. MacPhee, J. R. Taylor, and A. L. Chaney

SOME DATA ON PARTICULATES FROM FUEL OIL BURNING. Proc. Air Pollution Control Assoc., Semi-Ann. Tech. Conf., San Francisco, Calif., 1957. pp. 118-32.

This paper describes the nuisance effects and presents some data regarding the nature of particulate emissions from fuel oil burning. A brief examination of particulates from the combustion of heavy fuels oils was made. The coke-like cenospheres have been the cause of sporadic complaints in residential areas near large consumers of fuel oil. The ash and sulfur contents of the fuel as well as particulate loadings for both PS 400 and 4 degree API oils were quite similar. In large boilers of the type tested the ash content of the fuel (barring deposition in the boiler) can account for about one-tenth to one-quarter of the total particulates. The appearance under the microscope of the so-called ash portion of the particulates collected at 700 F. in an electrical precipitator was similar to sand. This material contained no free sulfuric acid. Limited tests indicated that the quantity cenospheres varied widely in different sources, and comprised from one-quarter to one-half of the total particulates. Sulfates (calculated as SO3), which includes sulfuric acid, amounted to 17 and 25% of the total particulates in two power plant boilers. On the basis of comparable power outputs, gas produces about one tenth the total particulates that result from the combustion of heavy oils.

05846

F. J. Adams

DEVELOPMENT AND INITIAL OPERATION OF OCR PACKAGED COAL-FIRED BOILER 20,000 TO 50,000 LBS./HR. Preprint. (Presented at the Industrial Coal Conference, Lafayette, Ind., Oct. 8, 1964.)

Design criteria for capacity, pressure, temperature, rail transportability, efficiency, coal, load range, and stack discharge with dust collectors are stated. Design limitations of size, stoker size, furnace volume, gas pass areas, reinjection, stack discharge collector are outlined. Specifications for the final design are tabulated. The most notable achievement was the operation of an entirely new product to burn coal with almost no start-up difficulties whatever.

06111

T. Takakuwa

EFFECT OF CENTRALIZED HEATING SYSTEM. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc. Tokyo) 3, (5) 15-20, 1966. Jap.

Methods of central heating are by thermal-electric system, nuclear energy district heating system, and by use of large boiler houses. The thermal-electric system has the highest efficiency and is the most economical. The conversion rate of steam into electricity is less than 30%, but if the lost steam is used for heat, the percentage rises to 75 to 80. Large boiler houses use coal, heavy oil, and natural gas as fuel. However soot and SO2 are emitted from the combustion of the fuels. Dust fall for particles 100 microns, 10 microns, 1 micron, and 0.1 micron in size is tabulated per square meter of area. While dust collectors may cut down on the amount of soot, the SO2 produced by burning heavy oil is not so easily eliminated. One counter measure against SO2 is to build high chimneys (for example, at least 390 ft high as in West Germany). The use of district heating in Germany, United States, Russia, France, and Sweden are described. The fact that almost all Japanese houses are only one or two stories high makes district heating difficult. The benefits will first be felt in new apartment buildings and commercial structures of many stories.

06578

RESTRICTING EMISSION OF DUST FROM MANUALLY-OPERATED CENTRAL- HEATING BOILERS, CAPACITY 600,000 CAL/HR. AND LESS, FIRED WITH SOLID FUELS. (Staubauswurfbegrenzung Handbediente Zentralheizungskessel fur feste Brennstoffe mit Leistungen bis etwa 600 000 kcal/h.) VDI (Verein Deutscher Ingenicure) Kommission Reinhaltung der Luft, Duesseldorf, Germany. (VDI No. 2115.) 13 pp. (June 1961). Ger. (Tr.)

This specification is applicable to warm-water and low-pressure central-heating boilers with furnaces for solid fuels, capacity 600,000 kcal/hr and less, operated manually under natural draft (no blower). The aims are to characterize the causes leading to the formation of dust (fly-ash, cinders, and eventually together with soot and other non-gaseous and combustible components) from central-heating boilers for solid fuels; to recommend measures for the reduction of dust emission; and to establish guide lines for the restriction of permissible immission.

06687

FLY ASH SYMPOSIUM BRINGS 550 TO PITTSBURGH. Elec. World 167 (16), 97-100 (Apr. 17, 1967).

International collection rates and beneficial disposal of the boiler by-product are discussed. The problems of disposal by dumping and by marketing are explained. The practical applications of ash are cited, stressing its addition to concrete as a pozzolan and as sintered aggregates. As an additive, it lightens the mass weight, strengthens the mixture, results in low water content and heat generation and finally, cuts costs.

07975

Byers, R. E.

COMBUSTION AIRFLOW: ITS MEASUREMENT AND CONTROL. TAPPI, 50(4):52A-58A, April 1967. 8 refs.

Investments in new boilers and auxiliary equipment show a poor return if they do not perform as an integrated unit, and frequently poor performance is synonymous with unreliable airflow measurement. Equally common is the conversion of a unit for multifuels which has intricate operating procedures and unsafe fuel air ratios. Very few plants escape the symptoms and complications of inaccurate airflow, indicating that the importance of this measurement is not appreciated, nor has the responsibility been clearly defined. Air flow primary element devices that have been used on the clean air side are evaluated. While some of these are adaptable to gas passes, their effectiveness would be greatly reduced by fly ash and maintenance problems. There is no perfect primary airflow element or universally accepted location, and the configurations of ducts and dampers may not be conducive to a good installation.

08200

Gurinov, B. P.

THE EFFECT OF COMBUSTION METHOD AND OF FUEL TYPE ON THE CONTENT OF 3.4-BENZPYRENE IN SMOKE GLASS. Gigiena i Sanit., 23(12):6-9, 1958. 5 refs. Translated from Russian by B. S. Levine, U. S. S. R. Literature on Air Pollution and Related Occupational Diseases, Vol. 4, p. 260-264, Aug. 1960. CFSTI: TT 60-21913

A study was made to determine the effect of different methods of fuel burning on the content of 3,4-benzpyrene in smoke gases. Methods of burning hard fuel differ in different plants; the pulverized and layer bed methods are examples of fuel burning methods most commonly in practice. Both methods of fuel burning were investigated. Dust samples were collected from boiler room smoke flues by an appropriate aspiration method. Two of the boilers burned coal from the vicinity of Moscow, one burned anthracite, and one burned peat. Analogous investigations in boiler rooms using oil as fuel showed that the process of oil burning liberated the greatest amount of carcinogenic substances. the method of layer or bed burning in non-mechanized furnaces produced considerably greater quantities of 3,4-benzpyrene than in mechanized furnaces; chamber burning of powdered fuel did not produce any carcinogenic substances in smoke discharges. It is recommended that boiler rooms using the bed or layer coal burning method should be equipped with mechanized furnaces; boiler rooms with non-mechanized furnaces should be replaced by central regional boiler rooms and heating centers.

08255

Fauth, Ulrich and Walter Schule GASEOUS AND SOLID EMISSIONS FROM OIL-FIRED STOVES. Staub (English translation), 27(6):1-11, June 1967. 10 refs. CFSTI: TT 67-51408/6 (HC $2.00)

Emission from oil-fired furnaces provided with vaporization burners, or atomizers was investigated. The emission of sulfur dioxide, sulfur trioxide, carbon monoxide, and solids (soot and ash) from furnaces of small and medium capacity was investigated. Three oil-fired stoves with vaporization burners, two with atomizers, and a steel heating boiler with a fire-brick combustion chamber were tested. Two commercial extra-light fuel oils were used. When used within its design load range with corresponding drafts, the vaporization burner has a sufficiently low soot emission. Comparatively large soot formation is possible when the oil viscosity is varied, and at extreme draft. Soot formation in atomizers is determined by their suitability for the respective boilers and their setting. This applies both to the installation of the plant and to their inspection, necessary at certain intervals. CO emission in oil heaters is closely related to soot formation. When soot emission is sufficiently small, CO formation is insignificant as regards air pollution. The sulfur contained in the fuel oil is emitted in the flue gas in the form of sulfur dioxide (70 to 80%) and sulfur trioxide (1 to 3%). The remaining sulfur is adsorbed to the soot as SO2 or SO3. Whether, and to what extent SO3 reaches the atmosphere in the flue gases depends mainly upon the temperatures in the furnace and the flue-gas duct (furance pipe, stack).

08374

Strauss, Werner and I. B. Speedie

THE FORMATION OF ACID SMUTS IN OIL FIRED KILNS AND BOILERS. Staub (English translation), 27(7):25-30, July 1967. 17 refs. CFSTI: TT 67-51408/7

A simulated flue gas containing sulphur dioxide (0.029 percent) water vapour (6.1 percent) and air (93.8 percent) was passed over different flame carbons which have been deposited on the walls of a 3 in. diameter verical glass tube at simulated chimney temperatures (110 deg. C to 190 deg. C). The total sulphur in the carbon deposit was determined and indicated the following. If the tube walls were of glass, then the total sulphur fell from 0.84 percent at 110 deg. C to 0.45 percent at

190 deg. C. If a trace of sulphur trioxide (9ppm) was added, then sulphur was found to be 1.16 percent at 150 deg. C and 0.90 percent at 190 deg. C. If traces of iron oxide were present, the sulphur content increased from 0.87 percent to 1.5 percent at 190 deg. C. These trends indicate that traces of iron oxides tend to favor higher sulphur adsorption, particularly at the higher temperatures.

08615

Short, W.

SOLIDS EMISSION IN RELATION TO RECENT LEGISLATION. Steam Heating Eng. (London), 37(432):28-37, Nov. 1967.

A review of solids emission in relation to recent legislation is presented. The control of solids emission both in regard to legal requirements and equipment available is discussed. The topics discussed are: oil firing, grit arrestors, chimneys, and additives.

08641

Sullivan, K. M.

THE OPERATION OF A VEKOS POWERMASTER COAL-FIRED FIRETUBE PACKAGE BOILER. Clean Air (J. Clean Air Soc. Australia New Zealand) 1(1):17, 19-23,25, 1967.

Tests using bituminous coal from New S. Wales were carried out on a coal fired packaged boiler having a rated capacity of 3,450 lbs/hour of saturated steam from and at 212 deg. F. (100 H.P.) and 150 psig. working pressure installed at the Fuel Development Centre of the State Electricity Commission of Victoria. The object of the test was to access the capabilities of the boiler when operated with several bituminous coals of varying characteristics. The boiler was examined for ease of light up, response to load fluctuations, ability to maintain rated load, degree of attention required by the boiler attendant, ability to conform to statutory Clean Air Regulations and operating efficiency. The boiler operated at high efficiency over a range of loads. Correct adjustment resulted in the boiler operating at all times within Clean Air requirements. Response to load fluctuations and ability of the boiler to continuously exceed rated load was better than anticipated. Attention to the boiler during operation was negligible. Manual ash clearing was required, but was not sufficient duration, or frequency, to cause concern. The satisfactory results of testing, when combined with the ease of installation of the fully packaged boiler and its initial competitive cost, indicate that the unit should have a wide application on the Australian market.

08642

Walker, A. B.

EMISSION CHARACTERISTICS FROM INDUSTRIAL BOILERS. Air. Eng., 9(8):17-19, Aug. 1967.

The ability to predict emission characteristics of industrial boilers becomes increasingly important to operators as air pollution regulations become more definitive. A statistical study by a joint technical committee of the American Boiler Manufacturers Association and the Industrial Gas Cleaning Institute (ABMA-IGCI study) has resulted in an as yet unpublished compilation of data on particulate emissions. These data represent estimates on the minimum efficiency requirements to meet typical, present quantitative emission codes and clear stacks. The results of the study for the three methods of coal firing (stoker, cyclone and pulverized coal) in steam generators are discussed and presented graphically.

08820

Tomczynska, Jadwiga and Janina Jurkiewicz

INDIVIDUAL BOILERS AND BOILER HOUSES AS SOURCES OF ATMOSPHERIC CONTAMINATION IN WARSAW. ((Kotlownie zakladowe i osiedlowe jako zrodlo zanieczyszczenia powietrza w warszawie.)) Text in Polish. Gaz, Woda Tech. Sanit. (Warsaw), 38(6):196-199, 1967. 6 refs.

A study to determine the cause of atmospheric pollution in Warsaw was undertaken. Air was aspirated at a distance of three meters from chimneys in Warsaw, and 1 liter samples were obtained and shaken with 250 ml. distilled H2O. This solution was then analyzed and a determination was made of soluble and insoluble organic and inorganic materials, and the S-containing compounds. All values were converted to long tons per cu. m. per month. It was found that the amounts of dust were gradually increasing (from 25.1 long tons per cu. m. in 1961 to 28.8 long tons per cu. m. in 1962). This increase in values cannot be ascribed to stepped-up industrial development because in a typical industrialized section of Warsaw in 1962, this value was only 16.7 tons. The increase of SO2 was particularly pronounced. During the winter months the SO2 was eight times as great as during the summer months, showing clearly that the boilers for apartment heating are the main source of air pollution in Warsaw.

09016

Shagalova, S. L., M. M. Rubin, B. D. Katsnel'son, I. N. Shnitser, D. I. Parparov, V. S. Patychenko, B. N. Barbyshev, S. I. Zaraiskii, L. S. Foshko, A. A. Madoyan, and A. I. Kul'chitskii

RESULTS OF TESTING 10T/H PF BURNERS OPERATING ON ANTHRACITE. ((Rezul'taty ispytenii moshchnykh pyleugol'nykh gorelok proizvoditel'nost'yu 10 t/ch po ASh.)) 4 refs. Thermal Eng. (English translation of: Teploenergetika), 14(1):16-20, 1967.

The design of 10 ton/hr pulverized anthracite coal burners is discussed. Both double scroll and scroll-vane burners are considered. Tests were conducted on a large steam boiler employing the burners and test results are discussed. Efficiency of the big burners was the same as for smaller ones. The slag removal factor was about 15% with no slag formation on the burner. Nozzles in the internal ducts of the scroll-vane burners burned out after 500 hours, while those in the double scroll burners, which had a smaller angle of divergence, burned out after 5000 hours. Data on combustion efficiency, proper excess air quantities, and operational variables are discussed.

09161

Gronhovd, G. H., R. J. Wagner, and A. J. Wittmaier

COMPARISON OF ASH FOULING TENDENCIES OF HIGH- AND LOW-SODIUM LIGNITE FROM A NORTH DAKOTA MINE. In: Proc. Power Conference 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966, Vol. 28, p. 632-642. 4 refs.

The rate of fouling, as determined both by boiler performance and by probe tests, is much greater when burning lignite having 8 to 10 percent sodium oxide in the ash compared with burning lignite having less than 2 percent sodium oxide in the ash. The tests indicate a remarkably high ash collection efficiency of the boiler tubes on the unit tested. Based on short-time dust loading tests, only 25 and 40 percent of the input ash can be accounted for in the flue gas for the high- and low-sodium coals, respectively. Sulfur oxide determinations indicate that the sodium level has a profound effect on the SO2 content of the flue gases. The SO2 increased from about 450 to 850 ppm when changing from high- to low-sodium coal.

With low-sodium coal, nearly all the coal sulfur can be expected to appear as SO2. Based on the results of these tests, a program designed to supply Hoot Lake Power Station with lignite containing a predetermined level of sodium has been set up. Using two loading shovels at the mine and adjusting the number of trucks serving each shovel, the lignite is blended at the tipple to provide a sodium level determined by the expected electrical load at Hoot Lake. Minor electrical load adjustments can then be made, if necessary, to accomodate the expected lignite blend. Sampling and analysis at the plant have shown a very good correlation with the expected sodium percentages, as predicted by the blending operation at the mine. Plant operating results from the first three months using this procedure look very promising.

09539

Zabroske, Tony A.

BOILER CONVERSION REDUCES COSTS AND AIR POLLUTION. Plant Eng., 22(6):96, 98, March 21, 1968.

The new, converted boilers at the Stewart-Warner Corp. are described. Total cost for the conversion of three 500-hp. water tube boilers from coal to a combination of gas and oil firing was $79,221. A true internal nozzle-mixing type, steam-atomizing oil burner was installed as well as a 50,000-gal. oil tank. Following the conversion, cost of operation has been reduced, the salary of four firemen eliminated, maintenance costs lowered, housekeeping easier, smoke control better, and coal and ash handling eliminated.

09831

Walsh, Robert T.

GASEOUS AND LIQUID FUELS. In: Air Pollution Egineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 507-514, 1967. GPO: 806-614-30

The burning of gaseous and liquid fuels is so commonplace that it enters directly into a vast number of air-polluting processes. The burning of any fuel under less than optimum conditions produces some quantities of carbon, ash, and unburned and partially burned hydrocarbons. In addition, many fuels contain sulfur and metallic compounds that are, even in the oxidized state, air pollutants. Air contaminants generated from fuel burning fall into three categories: (1) Carbon and the unburned and partially oxidized organic materials that result from incomplete combustion, (2) sulfur oxides and ash directly attributable to fuel composition, and (3) oxides of nitrogen formed at firebox temperatures from oxygen and nitrogen of the air. Incomplete combustion products can usually be held to tolerable minimums with proper operation of modern burner equipment. Sulfur and ash emissions are governed by the fuel makeup. Nitrogen. Nitrogen oxide concentrations are primarily functions of firebox design and temperature. The causes of such phenomena as black smoke, white smoke, sulfur and nitrogen oxides, and particulate emissions are discussed. Compositions of common fuel gases, fuel oils, and their combustion products (both gaseous and solid) are tabulated. Sulfur removal from fuels and municipal regulations limiting sulfur compound emission and sulfur content in fuels are discussed. Combustion products of any given fuel may be determined by the method illustrated.

09832

Walsh, Robert T.

GAS AND OIL BURNERS. In: Air Pollution Egineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS- Pub-999-AP-40, p. 514-525, 1967. GPO: 806-614-30

A burner is essentially a triggering mechanism used to ignite and oxidize hydrocarbon fuels. In general, burners are designed and operated to push the oxidation reactions as close as possible to completion with the maximum production of carbon dioxide and water, leaving a minimum of unburned and partially oxidized compounds in exhaust gases. General burner principles are presented with emphasis on major design and operation variables that affect air pollution. A burner consists primarily of a means of metering the two reactants, oxygen and fuel, and a means of mixing the reactants, oxygen and fuel, and a means of mixing the reactants before and concurrently with ignition. Liquid fuels require vaporization before efficient combustion can occur, and some form of atomizing (mechanical high or low pressure air, steam) is employed. Performance of liquid fuels depends heavily on viscosity; the viscosity-temperature relationship is discussed and graphs of the relationship are presented. Flame characteristics such as lifting, yellow tip, and flashback are determined by the primary and secondary air rates in the burner. Air fuel mixing is accomplished in a venturi, orifice multiple-port or forced draft device. The burning of combustion fuels can produce sulfur oxides, inorganic ash, oxides of nitrogen, carbon, and unburned and partially oxidized hydrocarbons. Most of these contaminants, notably sulfur oxides and inorganic ash, are attributable directly to the fuel and are independent of equipment design or operation. The principal air contaminants affected by burner design and operation are oxidizable materials--carbon, carbon monoxide aldehydes, organic acids, and unburned hydrocarbons. To a lesser degree, burner design can also affect oxides of nitrogen, but these emissions are dependent largely upon the design of the furnace and other combustion equipment. Emissions from gas-fired and oil-fired equipment are itemized and the ash and sulfur oxide product of oil and gas combustion are discussed.

10075

Williams, A. F.

OIL FIRING AND ODOUR PROBLEMS. (Due Olfeuerung im Hinblick auf Emissionsprobleme.) Text in German. Schweiz, Arch. Angew, Wiss. Tech. 31(4):105-112, April 1965. (presented at the S.V.M.T. Meetin Zurich, Switzerland, Sept. 11, 1964, Preprint in English.)

Smoke and smells are indicative of incomplete combustion. We propose to deal with underlying causes and curative measures which concern mainly the design and operation of the combustion appliance We shall discuss the various types of burners which are being used, particularly those which are prevalent in Switzerland for room and whole house heating. These are mainly pressure jet burners with so pot burners rated 15000 k cal/h. and above and operated on distillated gas oil. We shall comment on the relative merits of ON OFF and HIGH/LOW fire operation and quote test results for smoke an unburnt hydrocarbons produced by various burners during continuous firing or intermittent operation. Such unburnt hydrocarbons can give rise to unpleasant odours. We shall show that a low smoke conditio is related primarily to good draught and an optimum excess air valu inside the fire box. Various new attampts to procude small, highly efficient atomizing burners will be mentioned. These include ultrasonic atomization and the Ventres blue flame, atomizing with vaporising burner. Lastly, in reference to typical Swiss oil quali and the standards set by SNV Institute, we shall give some results showing the influence of aromatic content of the oil on its smoking propensity. Some mention will also be made about sulphur in the fu and SO_2 emission from the chimney. (Author's summary, modified)

10735

J. Beighton

GRIT AND DUST. WITH PARTICULAR REFERENCE TO THE WORKING PARTY REPORT. Smokeless Air, 38(146):266-269, Summer 1968.

Appreciating the need for more information of grit and dust, the British Ministry of Housing and Local Government set up in 1964 a working party on grit and dust emissions. The report of the working party endeavors to offer good working levels that should be obtainable from a normal plant properly designed. Eight of the points covered in the report are discussed.

10743

Christie, John

THE PROBLEMS OF SMOKE CONTROL. Smokeless Air, 38(146):257-262, Summer 1968.

The problem of smoke control are found in both domestic and industrial furnaces. The household open type fire when burning bituminous coal can produce a considerable amount of smoke and since discharge into the atmosphere is at a low level the pollution problem is aggravated. It is the job of the local authorities in Great Britain to deal with smoke control violations. The problems of industrial control are more complex because of the great variation in the industrial plants under consideration. However smoke attributed to industrial plants has been reduced by 50% since 1960. Important factors in this improvement are the recognition of the relationship of smoke emission to inefficient use of fuel.

12120

Duzy, A. F.

AMERICAN COAL CHARACTERISTICS AND THEIR EFFECTS ON THE DESIGN OF STEAM GENERATING UNITS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1959. 13 refs. (Presented at the American Society of Mechanical Engineers, Annual Meeting, Atlantic City, N. J., Nov. 29-Dec. 4, 1959, Paper 59-A242.)

Important coal characteristics are considered with respect to the design of steam generators, including the major components from the coal bunker outlet through fuel equipment, furnace, convection sections, air heaters, and dust collectors. Size content, moisture content, volatile-matter content, calorific value, ash content, and ash-fusion temperature are discussed, together with sulfur content, size distribution, and grindability. Theoretical air requirements are determined for stoker-fired boilers, boilers fired by pulverized coal, and furnace cyclones. Consideration is also given to the deteriorating quality of coal with respect to quantity and characteristics of the ash. The unavailability of cleaner steaming coals will necessitate improvements in metals, methods of controlling obnoxious flue-gas constituents, methods of ash disposal, and steam-generator design.

12975

Yamada, Go

CORROSION ATTACK OF BOILERS BURNING HEAVY-OIL. (Juyu boiler no fushoku shogai). Text in Japanese. Netsu Kanri (Heat Engineering, Tokyo), 21(3):2-9, March 1969. 5 refs.

Sulfur trioxide is a major cause of corrosion in boilers burning heavy oil. Sulfur compounds in heavy oil are oxidized to SO_2 and SO_3 during combustion. Sulfur trioxide combines with water vapor to form sulfuric acid, which corrodes surfaces at temperatures below the acid dewpoint of flue gas. Maximum corrosion occurs at 30-40 C lower than acid dewpoint. Meanwhile, on high temperature surfaces, alkali metal sulfates, formed from inorganic compounds, sulfur oxides, and oxides of vanadium accumulate, impede thermal condition, and cause corrosion. Sulfur trioxide is considered to be formed by (1) the reaction between SO_2 and O_2 in the vapor phase, (2) the oxidation of SO_2 in flame, and (3) the contact oxidation of SO_2 on metallic surfaces. Calculating the conversion rate of SO_2 to SO_3 at equilibrium in (1), the greater the O_2 and the lower the temperature, the larger the rate becomes. However, equilibrium does not occur in boilers, so the actual conversion rate is 1 to 4%. In (2), the greater the amount of sulfur included in the oil and the hotter the flame, the greater the amount of SO_3 formed. These findings suggest that combustion with low excess O_2 can reduce corrosion. Low-temperature corrosion can additionally be controlled by additives, such as ammonia, magnesium and calcium compounds; high temperature corrosion by carbonates, hydroxides, and oxides of alkaline earth metals.

13794

Gallagher, John T.

COST OF DIRECT-FIRED HEATERS. Chem. Eng., 74(15):232, July 17, 1967.

Two curves are given to help estimate the material and shop fabrication costs of radiant-convection and all-radiant heaters. Heater costs are normally compiled as $X/million Btu/hr of absorbed duty. The first curve relates the approximate purchase price of heaters to absorbed heat duty. Twenty million Btu represents the economic boundary for shipment of the heater to the field in one piece. Labor costs are greater when on-site assembly must be made. All-radiant heaters cost less initially than radiant-convection heaters of comparable size. Quite often though, the economics may favor the higher initial cost of the radiant-convection heater with its correspondingly lower fuel requirements and operating costs. An illustrative example is provided.

13807

Le Bouc, F.

AEROTHERMOCHEMICAL STUDY OF FURNACES AND BOILERS. (Etude Aerothermochimique des Fours et Chaudieres). Text in French. Rev. Inst. Franc. Petrole, 22(5):849-892, May 1967. 28 refs.

A synthesis was made of the results obtained on experimental furnaces by the Fondation de Recherches Internationales sur les Flammes which emphasized the importance of recycling phenomena in furnaces and the major role of momentum at the burner nozzle in combustion development. The theoretical aspect of recycling is considered, together with experimental results obtained both on the furnace and on the cold model. The development of the chemical reaction of combustion was examined in terms of the various parameters that affect the combustion mixture. An interpretation was made of the thermal properties of flames obtained with different types of burners. (Author abstract modified)

13832

Pope, Evans and Robbins, New York

COAL-FIRED HEATING PLANT PACKAGE: PHASE II REPORT. OCR Contract 14-01-0001-242, 63p., Nov. 1, 1963. CFSTI: PB 181-585

A complete steam generating package consisting of a bellied-in header innovation of an 'A' type boiler with a drawer type, single feed spreader stoker, forced draft fan, ash reinjection/over-fire air system, and combustion feed and control has been devised as the ideal combination for a packaged coal-fired boiler. The design provides for a specially designed dust-collector induced draft fan, and optional economizer, package to be field installed as a single unit on top of the boiler drum. Automation is achieved to the extent that only one man is required for normal operation of the plant. Boilers, coal, and ash handling systems operate on a fully automatic basis. The use of a continuous dual-purpose drag chain is an integral part of the design, the upper run of the chain delivering coal to all boiler hoppers and the lower run removing the ashes simultaneously. Considerable savings in erection costs have been achieved by extensive packaging of plant auxiliary and construction components. If a comparison is made with recent boiler plant construction costs, it can be seen that this type of boiler plant can be erected for a fraction of the cost of a traditional field-erected plant. (Author summary modified)

13855

Violet, P., A. Aynard, and G. Dumarchey

CHECK ON THE OPERATION OF COMMUNAL CENTRAL HEATING BOILERS IN LYONS DURING WINTER 1967-1968. (Controle du fonctionnement de chaudieres de chauffage central collectif a Lyon pendant l'hiver 1967-1968). Text in French. Pollut. Atmos. (Paris), 11(41):15-19, Jan./March 1969.

The Lyons Health Office, working in collaboration with technicians of the Association Lyonnaise des Proprietaires de Machines a Vapeur et Electriques and with financial assistance of the Centre Interproffesionel et Technique d'Etudes de la Pollution Atmospherique, carried out inspections, during the winter of 1967/1968 on 44 boilers whose calorific capacities ranged from 170 therm/hr to 5015 therm/hr. Thirty-nine units burned fuel oil and five coke or coal. In 97% of the cases, the Bacharach index was below 6. In 91% of the cases, the temperature of the smoke was below 300 C, with CO2 exceeding 9% for 44% of the operations checked. Forty-seven boilers, ranging from 50 to 1250 therm/hr, already checked in 1966/1967, were again inspected. A slight improvement was noted with regard to combustion. (Author abstract modified)

15375

Fritsch, W. Hans

RESONANCE PHENOMENA IN FLUE STACKS. I. (Resonanzerscheinungen an Schornsteinen. I). Text in German. Oel Gasfeuerung, 14(1):20-37, 1969.

The trend of ever narrower flue stacks has focused attention on resonance phenomena in the boiler-flue stack system. The basic physical concepts of oscillations, damping, and resonance and their mathematical descriptions are reviewed. While the flue stack alone has one resonance frequency, the boiler plus flue stack system has two or more. The flame in the boiler depends on the ambient pressure and follows the oscillations with an in-phase and a quadrature component. The flame is able to maintain steady state oscillations if the damping constant of the flameless system is equal to (m/2)/(282,000/Q) - n, where Q in kcal/cu m/hr is the energy density of the boiler furnace and m and n are the experimentally determined relative values of the in-phase and the quadrature flame fluctuations. Model experiments using 2 to 4-long tubes with 100 mm diameter and audioacoustic measurement equipment are described. In this model, typical pressure amplitudes of 20 mm water and resonance frequencies up to 200 Hz were measured. For different geometries, a dimensionless parameter, PI, which allows extrapolation to all stack dimensions can be determined. The concept of the phase diagram of an oscillator is discussed. A numerical example with oscillograph photographs illustrate the usefulness of model measurements.

16836

Siegmund, C. W.

AIR POLLUTION: WILL DESULFURIZED FUEL OILS HELP. ASHRAE (Am. Soc. Heating, Refrig. Aircond. Engrs.) J., 11(4):29-33, April 1969. 3 refs.

The general effect of air quality regulations which limit fuel oil sulfur content will be a trend toward better fuel oils which will give fewer operating problems. The changes which occur will be similar whether the fuels are made from natural low sulfur crude or by desulfurizing higher sulfur content components. The fuels will be lower in viscosity, which means easier handling and better atomization. They will be lower in ash content so superheater deposit and corrosion problems will be minimized. They will tend to make fewer stack solids. The problems caused by SO3, cold end corrosion and acid smuts formation, will be eased, but good combustion control will still be required. They may have higher pour points, but simple changes to storage facilities will overcome any flow problems. It is expected that these fuels will be somewhat more expensive than current fuels due to additional processing costs or the cost of transporting fuel to an area not normally tributary to the source. However, a substantial part of the increased fuel costs may be compensated for by decreased operating costs as a result of the improved fuel quality.

16949

Dept. of Interior, Washington, D. C., Office of Coal Research

OFFICE OF COAL RESEARCH ANNUAL REPORT 1968. 56p., 1968.

This report of OCR activities for calendar year 1967 gives detailed attention to the pilot plant program and to anti- pollution benefits expected to result from the projects under development. The following pilot plants are described: a flyash brick plant for determining the commercial possibilities of flyash-based structural materials; (2) a plant for using pulverized coal to remove solids and dissolved organic substances from sewage and industrial waste waters; (3) a program to develop coal-fired boilers which use the fluidized-bed combustion process; and (4) a pilot plant for converting coal to gasoline. Various electric power projects are underway to develop a coal-energized fuel cell, a coal-fired electrogasdynamic generator, a coal-fired thermionic topper, and a coal-fired magnetohydrodynamic generator. All have the potential of achieving overall thermal efficiences of 55-60% or more, which would greatly reduce emissions of combustion products, and some of the systems have other beneficial anti-pollution features as well. The group of projects for developing practical methods of converting coal to pipeline- quality gas and synthetic petroleum would produce a coal-based fuel able to meet the most stringent air-pollution regulation, since the products must meet the same specifications as natural gas and petroleum for catalytic processing, and would thus have a negligible sulfur content. A number of OCR projects underway or planned are directed toward sulfur removal: the fluidized-bed combustion boiler program, the low-ash coal project, one of the liquid-fuel projects in which sulfur can be removed and recovered from char, and a program to produce low-sulfur boiler fuel using the Consol CO2 Acceptor Process. These are described briefly in terms of their implications for pollution control.

16990

Blokh, A. G.

DEGREE OF BLACKNESS OF DUST-CONTAINING GASES IN BOILER INSTALLATIONS. (Stepen' chernoty zapylennykh gazov v kotel'nykh ustanovkakh). Text in Russian. Energomashinostroenie (Moscow), no. 2:24-27, 1967. 7 refs.

The luminosity of boiler-plant combustion products, forming an optically semitransparent diffracting and absorbing emitting medium, depends on the concentrations and emissive properties of the triatomic gases, H2O and CO2, and on the solid particles, preeminently, of ash, carbon, and soot suspended in them. The degree of blackness of the tongue of semiluminous and luminous flames that may occur in combustion chambers of boiler plants can be computed from expressions using the optical density of the two gases H2O and CO2, the ash content of the combustion gases, the ash content of the fuel, the volume of the combustion gas, the temperature of the flame, and the diameter of the ash particles.

17017

Nikolaev, S. P. and S. A. Dymshits

DISCHARGES OF BOILER OPERATED (COAL BURNING) PLANTS CONVERTED TO GAS BURNING. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:93-96, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

To evaluate the efficiency of shale gas combustion chambers, discharge gases from six chambers were analyzed for sulfur dioxide, hydrogen sulfide, tarry substances, soot, element composition, and caloric value. The SO2 content of the gases ranged from 3.04 to 207.06 mg/cu Nm and the H2S content, from 0.46 to 4.67 g/100 cu Nm of gas. Products of incomplete combustion were CO, H2, and CH4. Tarry substances ranged from 0 to 32.61 mg/cu Nm. The soot present in the gases was in a high degree of dispersion. Caloric value of the gas was 3234 to 3576 cal/cu Nm in the morning and 3178 to 3632 cal/cu m in the afternoon. A statistical study of the data gathered in 19 discharge analyses indicated that incomplete combustion occurred frequently in the chambers. This is attributed in part to faulty chamber construction, inappropriate chamber size, changes in composition and pressure of the gas fuel, absence of control devices, and shortcomings of technical personnel.

17190

Hasegawa, Toshio

ON THE OUTLINE OF FUEL CONSUMPTION, INSTALLED BOILERS AND OTHER FURNACES IN OSAKA PREFECTURE. (Osakafu ni okeru baien hassei shisetsu to nenryo shohiryo no gaikyo). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(4):221-226, April 15, 1968.

The general status of fuel consumption of boilers and industrial furnaces in Osaka is described. The number of boilers and furnaces now in use indicates an increasing reliance on fuel oil as an energy source. Due to current improvements, newly installed boilers and furnaces show high rates of heat efficiency and thus high combustion rates. Classification of Osaka's 8317 boilers and 400 industrial furnaces in terms of their material composition indicates that 1173 furnaces consist of metal heating; 662, of reverberatory furnaces; and 534, of fusion furnaces. Some of these present problems related to smoke dust emission control. Specifically, the electric furnaces, iron fusion furnaces, glass fusion furnaces, and lead or aluminium fusion furnaces that are used by relatively minor plants, present financial and technical difficulties. This is in contrast to large plants which independently practice smoke dust control. Fuel oil consumption has increased markedly in the past seven years in Osaka, with the 1956 sale of heavy oil nearly four times that of 1958. Data from a survey of the relationship between fuel consumption and air pollution show that the total quantities of coal burned and heavy oil consumed was 1586.8 ton and 921.0 kl in the first three days of 1968; the daily average quantity used during the preceding December was 5399.8 tons and 2236.9 kl. Sulfurous gas density equivalent to fuel consumption showed a proportional increase in the three days when very small plants were operative.

17840

Gerlovin, L. I. and V. P. Sigachev

BOILER WITH HIGH DEGREE OF EXHAUST GAS UTILIZATION. (Kotel s glubokoy utilizatsiyey tepla vykhlopnykh gazov). Text in Russian. Sudostroenie, no. 10:32-34, Oct. 1968.

The boiler installation of the tanker Velikiy Oktyabr' is described. Some operating parameters are as follows: working pressure in separator, 9-10 kg/sq cm; temperature of superheated steam, 290-295 C; steam production under intermediate load, 3660 kg/hr; hydrodynamic drag, about 3.0 kg/sq cm; and resistance of gas channel, about 110 mm H2O. A circulation factor of about 3 was dictated by a tendency toward an increased temperature head due to a reduction in temperature of the circulating water to minimum (based on low-temperature corrosion considerations). Exhaust gas temperature (180 C) is determined by conditions designed to assure a minimum temperature drop of approximately 30 C between the gas and wall at the inlet under operating conditions.

19017

Johnstone, H. F.

REACTIONS OF SULFUR COMPOUNDS IN BOILER FURNACES. Ind. Eng. Chem., 23(6):620-625, June 1931. 12 refs. (Presented at the American Chemical Society Meeting, 81st, Indianapolis, Ind., March 30- April 3, 1931.)

In a furnace, the sulfur in coal is converted mainly into sulfur dioxide. Only about 2% is oxidized to the trioxide, regardless of the temperature or oxygen content of the gases. The concentration of sulfur trioxide in the stack gases is no greater, therefore, than that in the furnace gases. Flue dust has only slight catalytic action in the oxidation of sulfur dioxide. When the sulfur in the fuel exists as sulfuric acid, as, for instance, in petroleum residues, about 85% of the acid is reduced in the furnace to sulfur dioxide. The gases contain only slightly more trioxide than those from high-sulfur coal. When coal is fired on a stoker, about 30% of the sulfur remains in the ash, at least a part of which exists as iron sulfide. Particles of dust containing the sulfide adhere readily to one another and to metal surfaces, so that hard deposits build up readily both on boiler and economizer tubes. On boiler tubes, most of the sulfur in the slag is lost by oxidation of the sulfides and decomposition of the sulfates. At lower temperatures, the sulfates are stable and the slag contains a large proportion of sulfate sulfur, even above the condensation temperatures of the gases.

Concentrations of sulfur trioxide in the gases as low as 0.015% raise the dew point to 80-100 C. The hygroscopic nature of deposits containing ferric sulfate also causes moisture to condense at temperatures considerably above the dew point of the gases calculated from the partial pressure of water vapor in the gases. As solutions containing ferric sulfate act as strong catalysts for the oxidation of sulfur dioxide to sulfuric acid, the existence of these sulfates in the flue dust is responsible for an increase in the temperature range of corrosion by flue gases. Increased moisture content of the gases caused by leaks or by the use of steam soot-blowers will produce the same effect. (Author abstract)

19217

Kawada, Nobu

THE SAFETY MEASURE OF BABCOCK RECOVERY BOILER. (Babukkoku kaishu boira no anzen taisaku). Text in Japanese. Kami-Pa Gikyoshi, (Journal of the Japanese Technical Association of the Pulp and Paper Industry), 24(7):361-366, July 1, 1970. 2 refs. Babcock Hitachi Co. (Japan).

The safety of recovery boilers is causing very grave concern due to explosions. In the United States, the Black Liquor Recovery Boiler Advisory Committee has been organized by users, insurance companies, and boiler makers. Babcock Hitachi, in cooperation with Babcock and Wilcox Company, is making a B and W Tomlinson Recovery Boiler. Based on the discussions of a conference held in London, the recovery boiler is considered to be safe. The Emergency Shutdown Methods of B and W Tomlinson Boiler vary according to the situation. When the furnace contains water the method is recommended as an Emergency Shutdown Procedure by the Committee. The fourth item of an Emergency Shutdown Procedure is adapted only to a B. W. Recovery Boiler. An explosion by the reaction of smelting and water is very dangerous. An explosion occurs when the tube of the furnace and the screen tube are broken and water touches the smelt in the bottom of the furnace. Therefore, corrosion of the tubes should be avoided. A jet stem atomizer for a heavy oil burner has been used. This is the most suitable supplementary burner for a recovery boiler.

21166

Rutz, P.

BOILER PLANTS FOR BURNING INDUSTRIAL WASTES. Sulzer Tech. Rev. (Switz.), no. 3:99-108, 1968.

Not only the shape and chemical composition of industrial wastes but their calorific value and moisture content place special requirements on an incinerator boiler and grate. The chemical composition may dictate additional measures for protecting heating surfaces against corrosion. A high ash content in the fuel will have to be allowed for in grate design. The size of the grate will be decided by the hourly weight of the waste to be burned and the calorific value of the material. Most solid fuels in the form of pieces or chips can be burnt properly on simple stationary step grates, provided a second grate follows the step grate. These grates can be used in water-tube or smoke-tube boilers. Water-tube boilers are described that are capable of firing waste alone, waste together with oil, or oil alone. Using special charging and burner arrangements, it is even possible to fire solvents in combination with oil firing. A moving burn-out grate with air cooling below provides for the automatic ejection of ash and clinker at the bottom of the boilers. Rubber and plastic wastes can be fired satisfactorily only with the addition of light fuel oil burners. When large quantities of refuse are delivered to a boilerhouse in a short time, bunkering installations should be provided for short-term storage. In addition, waste- fired boilers must be equipped with efficient electrostatic precipitators, and the dust content of the flue gas and its grain size must be determined.

21363

Kawai, Sunao, Tadahiro Machiyama, and Mutsuo Koizumi

EXPERIMENTAL STUDIES ON A HOT-WATER BOILER WITH FLUE-GAS RECIRCULATION. Text in Japanese. Waseda Daigaku Rikogaku Kenkyusho Hokoku (Bull. Sci. Eng. Res. Lab., Waseda, Univ.), no. 41:38-45, 1968. 3 refs.

Experimental studies were conducted on the applications of a pre-combustion method with flue-gas recirculation to the reheating furnace. The furnace is thermally loaded by a hot-water boiler which is set up at the end of the furnace. In the experiments, the behavior of the boiler offered some interesting information. Some considerations of the operations from the circuit theoretic viewpoint are reported. The concept of operating point is clarified through the considerations, in spite of the non-linearities which exist in the boiler characteristics. The optimum operating point to maximize the water outlet temperature is found on the basis of the characteristics for values of the fuel and the feed water flow-rate. This fact shows the possibilities in an application of the optimizing control technique to the boiler.

21940

Marteney, Pierre J.

ANALYTICAL STUDY OF THE KINETICS OF FORMATION OF NITROGEN OXIDE IN HYDROCARBON-AIR COMBUSTION. Combust. Sci. Technol., vol. 1:461-469, 1970. 14 refs.

The kinetics of formation of nitric oxide in hydrocarbon-air combustion were studied. Two UNIVAC 1108 computer programs were utilized to obtain time-dependent concentrations of chemical species in a subsonic stream. Inlet conditions specified were the temperature, pressure, and composition. Inlet temperatures were varied from 1000 K to 2000 K at pressures of 1 to 10 atm for equivalence ratios of 0.8 to 1.25. The inlet composition was taken to be a mixture of non-reacted gases. Equilibrium in the nitrogen oxides is very slowly attained with respect to the carbon and hydrogen oxides. The implication of this result is that observations of NO concentrations well below equilibrium values in certain types of engine exhausts may be correlated with the kinetics of formation, and that combustion temperatures and residence times, rather than exhaust temperatures, determine the level of NO in exhaust gases. (Author abstract)

22800

National Academy of Sciences National Research Council,
Washington, D. C., Committee on Air Quality Management

ABATEMENT OF SULFUR OXIDE EMISSIONS FROM STATIONARY COMBUSTION SOURCES. NAPCA Contract CPA 22-69-31, COPAC-2, 75p., 1970. 27 refs. CFSTI: PB 192887

In surveying the sulfur oxide problem and U. S. energy requirements, it is estimated that the requirement for electricity will more than triple in the next 20 years and that the use of coal will triple by the year 2000. These projections are related to longterm environmental considerations, energy research, factors of fuel utilization, and time phases of technical developments. Support of technology development by the coal industry, equipment manufacturers, utilities, and the federal government is surveyed, and the present status of research and technology is reviewed, including brief discussions of numerous specific processes. It is concluded that commercially proven technology for control of sulfur oxides from combustion processes does not exist and that a high level of government support is needed in addition to industry commitments to develop the necessary control measures. Certain control approaches are suggested for support, and a 5-year plan for future work is presented in which complete development of the limestone process is given high priority. Elemental sulfur is considered a more desirable by-product than sulfuric acid or sulfur dioxide, and the technology and costs of this conversion need thorough study.

22955

Ivanov, V. P. and I. I. Chudnovskaya

INVESTIGATING SOME OF THE PROPERTIES OF OIL ASH DEPOSITS. Teploenergetika, 16(2):62-66, 1969. 3 refs.

Intensive fouling of convective superheater heating surfaces for a large-capacity gas/oil fired boiler was investigated by examining the ash deposits formed on the heating surfaces. The device used for this purpose was a specially designed sampler-calorimeter which simulates the heating surfaces. The sampler was installed near the pendent superheater at a point where the gas temperature was 1100 - 900 C, and the test lasted 1 -10 hrs. The intensity of fouling and the structure of the deposits depended largely on wall temperature, and the amount of ash deposits increased perceptively over the period of 5 to 10 hrs. Thermal conductivity coefficients were calculated for specimens of deposits, and the graphical analyses of the data showed that the differences in the structure of the layers contribute to the different coefficients of thermal conductivity. Porosity, crystal structure and size, and volumetric density were some of the factors causing the difference in the coefficients.

23313

Alkire, H. L.

AIR POLLUTION IN CAROLINE COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control and Caroline County Dept. of Health, Denton, Md., 19p., Jan. 1970. 15 refs.

The present survey emanated from the need of the Division of Air Quality Control of the Maryland State Department of Health to have a county by county statement, based on available information, on the status of air contamination in the various areas. The survey was made in accordance with authority granted under the Maryland Air Quality Control Act (Article 43, Annotated Code of Maryland, 1957 Edition and Supplement). Regulations have been adopted by the county governing the control and prohibition of open fires, the control and prohibition of visible emissions, and the control and prohibition of particulate emissions from fuel combustion. Amendments to these regulations which became effective on January 29, 1969 govern the sulfur content of all heating oils and of oil used in very large installations after July 1, 1970; prohibit removing air pollution control devices from motor vehicles as well as requiring that the devices be kept in operating condition; provide for the control of the discharge of gases, vapors or odors; and, in addition, are concerned with control of visible and particulate emissions from industrial and incineration operations. Plants at Denton and Ridgely fortunately have been located so that those communities are upwind of the prevailing west and northwest winds. Two poultry processing plants create the types of odors usually associated therewith but they are rurally located. There are no plants for the rendering of inedible portions of chickens in the county. Five dumps are used for the disposition of about 8500 tons of refuse annually. The burning of material is on an irregular schedule and is somewhat controlled. However, material is not covered frequently and the dumps are odorous. Investigations are under way with the aim of substituting sanitary landfills for the dumps. The disposal of home-generated trash and leaves in smaller communities and by burning is a general practice. The processing of clams near Ridgely produces some odors which escape into the town and may lead to objectionable conditions. However, some residents of the area reported that they were not of an objectionable nature. Smoke has been emanating periodically from the stack of milk plant in Greensboro, but this is resulting from improper operation of new equipment which was installed to correct previously unsatisfactory smoke emissions.

23314

Alkire, H. L.

AIR POLLUTION IN TALBOT COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control and Talbot County Dept. of Health, Easton, Md., 19p., Jan. 1970. 14 refs.

The present survey emanated from the need of the Division of Air Quality Control of the Maryland State Department of Health to have a county by county statement, based on available information, on the status of air contamination in the various areas. The survey was made in accordance with authority for the Secretary of Health and Mental Hygiene to adopt regulations governing the control of air pollution in the State. Regulations applicable in Talbot County have been adopted governing the control and prohibition of open fires, the control and prohibition of visible emissions, and the control and prohibition of particulate emissions from fuel combustion. Amendments to these regulations which became effective on January 29, 1969 govern the sulfur content of all heating oils and of coal used in very large installations after July 1, 1970; prohibit removing air pollution control devices from motor vehicles as well as requiring that the devices be kept in operating conditions; provide for the control of the discharge of gases, vapors or odors; and, in addition, are concerned with control of visible and particulate emissions from industrial and incineration operations. Most sources of air pollution in Talbot County, although relatively small and few in number, are clustered in the Easton area. Pollution generally is associated with the processing of vegetables, the shelling and drying of corn which create 'beeswing' chaff, and the processing of seafood. Other than in the Easton area, these are widely scattered and objectionable levels of pollution are localized. Almost all refuse material is disposed of in landfills. However, burning sometimes occurs at the Tilghman-Sherwood dump and occasionally at the St. Michaels dump.

23443

Wikstrom, O.

EXPERIENCE IN COMBUSTION OF HEAVY OIL WITH LOW SULFUR CONTENT. (Erfarenheter vid eldning med lagsvavlig tjockolja). Text in Swedish. Konf. Energi Och Miljo, Kungalv, Sweden, 1969, no. 4:1-5, 1969.

Advantages from burning natural low-sulfur oil include better combustion, lower consumption, and less boiler corrosion; disadvantages include higher cost and a higher pure point. The investment costs for a boiler with a running time of 300 hr/year and an annual repayment of 8% with a depreciation period of 10 years are one Swedish kronor(20 cents) per cu m. The profit, according to higher effect, is between 0.5 -1.0 Swedish kronor /cu m. From environmental aspects, the natural low-sulfur oil is preferable not only because of lower sulfur content but also because of lower particulate emissions.

23561

Morgan, George B. and Guntis Ozolins

THE IMPACT OF AIR POLLUTION ON THE ENVIRONMENT. Preprint, National Air Pollution Control Administration, Cincinnati, Ohio, Div. of Air Quality and Emission Data, 12p., 1970.

The population of a large part of the world has been exposed to polluted air for many decades and, in some cases, centuries. Significant increases are forecast for the future. If control actions are not intensified, air pollution may increase by a factor of six to ten by the year 2000. Before any meaningful control efforts can be carried out, we must know what the ambient levels of pollution are and how they relate to levels established as causing health or economic effects. Many pollutants have always been a part of the natural atmosphere. They are now called pollutants because, with man's help, they are now excessive in quantity. Particulate pollution is the most recognized and pervasive. Its health effects are functions of both particle size and composition. Another significant effect is that, suspended in the atmosphere, particulates reflect away part of the sun's energy and could result in an over-all lowering of the earth's temperature. Gases, 90% of all pollutants, are the second class of pollutant. Examples are sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, and hydrogen fluoride. A third major pollutant class is the family of hydrocarbons. These participate in photochemical reactions which result in the formation of secondary pollutants such as peroxyacyl nitrates, ozone, formaldehyde, other aldehydes, and ketones. It is from these secondary pollutants that the primary danger to both animal (including the human animal) and vegetable life arises. Numerous industrial processes and the ubiquitous automobile emit these assorted products that are a serious problem in the environment surrounding their source. Almost all human activity results in some form of air pollution, direct or indirect, particulate or gaseous. High-temperature combustion, automotive, industrial, and domestic, is the principal offender. Parameters that must be considered when evaluating effects of pollution include quantity, distribution, and environmental tolerance for pollutants, individually and in concert. Locally, micrometeorology and topography also require consideration. Of all identified pollutants, suspended particulates and sulfur dioxide have been the most extensively measured and studied. As analytical techniques become available, other pollutants will come under programmed surveillance. Among these are asbestos, mercury, lead, pesticides, fluorides, and biologically active metals. International assessment of these problems is necessary for the preservation of the biosphere.

23726

Land, George W.

COAL AND CLEAN AIR. Preprint, Society of Automotive Engineers, Inc., New York, 7p., 1970. (Presented at the Society of Automotive Engineers, Inc., New York, (Presented at the Society of Automotive Engineers, Earthmoving Industry Conference, Peoria, Ill., April 14-15, 1970, Paper 700552.)

Data on fossil fuel energy (coal, petroleum, natural gas) consumed in the U. S. since 1920 are presented to show that the increase in air pollution in recent years is not from coal, which has remained relatively constant on the average in quantities used. Evidence is also presented showing that less than 20% of the pollutants emitted into the air in a typical year arises from generation of electricit and space heating, the principal uses for coal. The combustion of coal produces solid and gaseous pollutants; almost complete control of particulates is technically and economically feasible, while control of gases, mainly oxides of sulfur and nitrogen, is much less advanced. Thus, low-sulfur fuels must be used; however, because of the shortage of low-sulfur coal in some areas (mainly the Midwest), gas or low sulfur oils are substituted. Increases in gaseous pollutants in the last 50 years are attributed to increased use of natural gas and petroleum, and it is concluded tha the nitrogen oxides and hydrocarbons together deserve much more control effort and research funds than they have received in comparison to sulfur dioxide, especially in view of their role in smog formation.

23745

Devorkin, Howard and Bernard J. Steigerwald

EMISSIONS OF AIR CONTAMINANTS FROM BOILERS AND PROCESS HEATERS. Los Angeles County Air Pollution Control District, Calif., California Dept. of Public Health, Berkeley, Public Health Services Washington, D. C., Community Air Pollution Program, Western Oil and Gas Assoc., Los Angeles, Calif., Air Pollution Control Committee, Rept. 7, 29p., June 1958. 9 refs.

Combustion of fuel oil and gas is a source of emissions to the atmosphere. The techniques and results of a stack sampling study to determine the extent of these emissions from combustion in oil refinery boilers and heaters in Los Angeles County are presented. A total of 21 stacks were sampled, using standard sampling procedures and methods. The results were evaluated in the form of total emissions and average emission factors. The average emission factors per unit of fuel used were calculated for each contaminant for combustion of both oil and gas. The contaminants measured include hydrocarbons, as hexane; sulfur dioxide; oxides of nitrogen, as nitrogen dioxide; particulate matter; sulfur trioxide; ammonia; aldehydes; and organic acids, as ascetic acid. Emissions of sulfur oxides are a direct function of the composition of the fuel, while the emission of the other contaminants are primarily influenced by combustion temperature, heater design, or air-fuel ratio rather than fuel composition. Comparison of the analysis of stack gases for SO3 with the measured SO2 emissions from these units gave an average ratio of SO3 to total sulfur as SO2 of 0.03. Of the 20 tests made for CO 14 were negative, five showed a trace less than 0.001%, and one showed a concentration of 0.003%; the emission of CO from boilers and process heaters was negligible.

24005

Cave, G. A.

DUSTS AND SMOKES IN FLUE GASES. Brit. Coal. Util. Res. Assoc. Monthly Bull., 10(3):61-70, March 1946. 98 refs.

Dusts carried by flue gases are considered with respect to their composition, mode of formation, and chemical and physical properties. The materials from which flue dust is formed derive in part from unburned carbon and in part from inorganic mineral constituents of coal. They consist of inherent as well as adventitious ash, and their composition may include most of the elements in the periodic table. With regard to boiler corrosion and deposits, the constituents of most interest are those that influence the fusability of the ash and those that determine the proportion of ash escaping as volatile material. Dust-producing materials are released and formed by decomposition, reaction, volatilization, and mechanical pickup. Properties of flue dust determining its accumulation on heating surfaces are density, size, thermal motion, reactivity towards gaseous flue-gas constituents, and electrical characteristics. Concentrations of dust in boiler gases depend on local conditions of gas movement; thermal gradient; the particular relationship between particle size, velocity, and direction of the gas stream; and on factors connected with the release of dust from the fuel bed. Size and basicity of ash particles or aggregates in a coal-dust firing system diminishes from the combustion chamber toward the chimney; solids emitted by the chimney may consist of highly siliceous and refractory single particles. Smoke-density meters are quite efficient for measuring smokes and suspended particles in flue gases at stack levels, and a variety of devices are available for separating dusts from flue gases. In general, the most effective meteorological element in controlling the concentration of smoke is turbulence.

24076

Sakai, Takeshi and Sachio Sugiyama

RESIDUAL CARBON PARTICLES YIELDED BY COMBUSTION OF ATOMIZED HEAVY- FUEL-OIL DROPLETS. J. Inst. Fuel, vol. 43:295-300, Aug. 1970. 18 refs.

The distribution and the mean diameter of coke particles discharged with flue gas from the combustion of atomized heavy-fuel-oil droplets in a furnace was studied in relation to the distribution of the atomized heavy-fuel-oil droplets. An analytical method of determining the coefficients of the Gamma distribution function was developed that is easier and more exact than the semilog method. The critical coke generating droplet diameter was derived from the combustion history of a single heavy-fuel-oil droplet, and the relationship between the initial droplet diameter and the diameter of the discharged droplet was parabolic. This conclusion was applied to the combustion of a cloud of fuel-oil droplets. Thus, theoretical equations defining the mean diameters and distribution of the coke particles with respect to the distribution of initial droplets were obtained. Data from these equations were compared with data from work on a pilot furnace. The distribution and mean diameter of the coke particles discharged from the furnace were determined mainly by the distribution of the initial heavy-fuel-oil spray and the properties of the fuel oil, but not by the fuel:air ratio. (Author abstract modified)

24219

Ancona, Giuseppe and Giancarlo Scavizzi

MODERN DIRECTIONS IN THE INDUSTRIAL COMBUSTION OF FLUIDS. (Moderni orientamenti della combustione industriale di fluide). Text in Italian. Termotechnica (Milan), 24(8):364-370, Aug. 1970. (Presented at the ATI National Congress, 24th, Bari, Oct. 1969.)

Some modern types of industrial burners for liquid or gaseous fuels are described. The methods for the liquid fuels atomization most widely accepted in the industrial practice--direct or return pressure, and auxiliary fluid impingement--are briefly examined and compared. The ranges are defined where the physical quantities involved in the process (pressure, viscosity, temperature) must lie in order to guarantee the best jet formation. A versatile and simple type of gas burner is described. It consists of a series of gas spuds directly fed from a ring manifold and projecting into the burner throat. This burner is in industrial operation with natural or refinery gas. The heat transfer problems are examined which can arise in the steam generators from the difference in emissive capacity between the flames from gas and from oil. The gas flame is usually non-luminous, and consequently the furnace absorption in gas operation is much lower than when burning oil. This causes a higher heat absorption of the convective parts downstream of the furance, with possible difficulties in keeping the steam temperatures below the tolerated limits during the gas operation at high boiler loads. These problems can be attenuated by creating a zone in the gas flame where the combustion is artificall poor. This causes a highly emissive soot particles cloud to be formed, increasing the heat transferred in the furnace by radiation. The other components of the burner--impellers and registers--are briefly described. Their combined effect in the air swirl and the flame shape are examined, together with the reasons which have led to their current design. (Author abstract modified)

24732

Spaite, Paul W. and Robert P. Hangebrauck

POLLUTION FROM COMBUSTION OF FOSSIL FUELS. In: Air Pollution-1970 Part I. 91st Congress (Senate), Second Session on S.3229, S.3466, S.3546, p. 172-181, 1970. 3 refs. (Hearings before the Subcommittee on Air and Water Pollution of the Committee on Public Works, March 16, 17, 18, 1970.)

Currently, emissions of fly ash, sulfur oxides, and nitrogen oxides by fossil fuel burning sources come to about 45 million tons per year in the United States, and consumption of fossil fuels is doubling every 25 years. These emissions originate in power plants industrial boilers, and smaller installations used for commercial and residential heating. Power production, which accounts for 70% of the present total sulfur oxide emissions from combustion and over 90% of the total anticipated in 30 years, is by far the most important source judged on the basis of total contribution from all combustion sources. Even when consideration of the nature of the control problem is limited to coal burning power plants, the problem of nonuniformity in the processes which must be controlled still is apparent. Factors such as plant size, plant age, and a host of considerations associated with location make each power plant a unique control problem. Oxides of nitrogen range from an estimated 9 million tons at present to about 25 million tons by the year 2000. Presently available equipment for fly-ash control does not efficiently collect particles less than approximately 1.0 micron in diameter. Fine particulates tend to remain in suspension in the upper atmosphere, where continued build-up of such materials could produce unacceptable worldwide climate changes. From the control point of view, combustion source can be divided into three classes with distinctly different characteristics as far as the nature of the control problem is concerned: boilers under 500 million Btu/hr capacity, existing boilers larger than 70 mw, and large new boilers that will be built in the future and for the most part will be 500-1000 mw in size.

24854

Feldkircher, James J.

REBIRTH OF A BOILERHOUSE. Preprint, American Society of Mechanical Engineers, New York, 5p., 1970. (Presented at the American Society of Mechanical Engineers Maintenance Conference, Fort Worth, Tex., 1970, Paper 70-PEM-5.)

The factors instrumental in the decision to convert the 27-yr old coal boilerhouse of a Midwestern industrial plant to natural gas are discussed. Existing equipment, steam loads, and demands, and operational and equipment problems of the old unit are described. After analysis of 10 different systems, one was chosen in which the boilers are converted to gas, an existing gas-fired boiler is relocated, and all new feed water equipment is installed. With this system, the life of the boilers are increased to a minimum of 20 yrs, all future all pollution problems are eliminated, peak steam demands for the next five years can be met, and capital and operating costs are reduced. A brief description of the new gas burner is included.

25142

Ehrenfeld, John R., Josette C. Goldish, Ronald Orner, and Ralph H. Bernstein

POLLUTION FROM STATIONARY FOSSIL-FUEL BURNING COMBUSTION EQUIPMENT TO 1990. A SYSTEMS STUDY OF EMISSIONS AND CONTROL. Preprint, International Union of Air Pollution Prevention Associations, 32p., 1970. 18 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., 1970, Paper EN-16G.)

The methodology used to determine present and future air pollution resulting from boilers is discussed. Unlike other studies, the approach used here does not try to determine emissions from fuel consumption data, but starts out with an equipment inventory. The inventory for 1967 was obtained from a variety of sources, includin equipment manufacturers and trade associations, government publications, NAPCA studies, state and local boiler inspection agencies, and air pollution control departments and trade journals. A computer program (STRAT) was developed to process this inventory which was reduced to a matrix of 5376 elements. The program calculates emissions from the capacity data and allows for a man-machine selection of subsets of equipment on which to apply control strategies. It will execute each strategy and recalculate emissions, annual costs of control, and initial capital outlay for equipment conversions. Projections of sales up to 1990 were obtained by using multiple regression models with economic data as the independent variables. Boiler inventories were subsequently obtained for 1975, 1980, 1985, and 1990 by adding the sales for the relevant time period to the 1967 inventory and subtracting the estimated retirements. The computer programs, STRAT was used to analyze these projections. Results of the sulfur dioxide, nitrogen oxides, and particulates emissions for 1967 and the projected emissions for 1975, 1980, 1985, and 1990 are summarized. Control strategies are being applied to these inventories by means of STRAT, by region, types of equipment, fuel types, and other variables. It is expected that the cost effectiveness of control strategies can be determined in a much more realistic way by means of the techniques described. (Author abstract)

25169

Johnson, G. M., C. J. Matthews, M. Y. Smith, and D. J. Williams

DISTRIBUTION OF SULFUR SPECIES IN THE BURNT GAS OF FUEL-RICH PROPANE-AIR FLAMES. Combust. Flame, 15(2):211-214, Oct. 1970. 11 refs.

The computed equilibrium distributions of 20 sulfur species in the burnt gas of fuel-rich propane flames as a function of fuel-air ratio are compared with the measured relative concentrations of three sulfur-containing species: sulfur dioxide, hydrogen sulfide, and carbon monosulfide. Measured concentration profiles (along the vertical axis of the flame) of these three species are also compared with the calculated profiles based on measured reversal-temperature profiles.

25196

Shannon, Larry J., A. Eugene Vandegrift, Paul G. Gorman, Eugene E. Sallee, and M. Reichel

EMISSION AND EFFLUENT CHARACTERISTICS OF STATIONARY PARTICULATE POLLUTION SOURCES. Preprint, International Union of Air Pollution Prevention Associations, 36p., 1970. 2 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-22F.)

A particulate pollutant system study was undertaken to overcome deficiencies in our knowledge regarding the nature and magnitude of particulate pollutant emissions from stationary sources in the United States. The objective of the study was to identify, characterize, and quantify the particulate air pollution burden resulting from stationary sources. A quantitative ranking is presented of staionary sources, projections of their potential emission levels up to the year 2000, and information on the effluent characteristics (particulate and carrier gas) of the major particulate pollutant sources. A ranking of sources on the basis of total tonnage of emissions per year was developed. Total tonnage emitted by a given source or industry was determined from four quantities: an emission factor for the uncontrolled source; the total tonnage processed per year by the source; the efficiency of control equipment used; and the percentage of production capacity equipped with control devices. In some cases computation procedures based on outlet grain loadings or material balances were also employed. The major stationary sources of particulates are electric power generation plants, the crushed stone industry, agriculture and related operations, the iron and steel industry, and the cement industry. Forecasts of the level of particulate pollutants emitted from stationary sources up to the year 2000 were developed by taking into account: changes in production capacity; improvements in control devices; and legislative or regulatory action to enforce installation of control equipment. These forecasts indicate that particulate emissions can be reduced to about one-sixth of the current level by 1980 through the installation of currently available control devices on all sources. The projections also suggest that reduction of particulate matter will most likely occur by installation of contro equipment on uncontrolled sources and by shifts to more efficient types of collection equipment rather than by any major improvements in the efficiency of a specific type of control device. A matrix of effluent properties for the major particulate sources is presented. Particulate characteristics discussed include particle size, solids loading, and chemical composition. Carrier-gas properties tabulated include flow rate and chemical composition. (Author abstract modified)

25638

PROTECTION AGAINST IMMISSION. (Immissionsschutz). Text in German. Rheinisch-Westfaelischer Technischer Uberwach.- Verein E.V., Jahresbericht, 1969:38-41, 1969.

The five principles promulgated in the framework of an intensified air pollution control campaign by the state of Nordrhein-Westfalen and adopted also by the other West German states postulate that all polluters be identified and included in the pollution control program, that the atmosphere be kept as clean as possible and not as dirty as just about tolerable; that the costs of the program be born equally by all polluters so that no competitive advantages arise; that the polluters bear the cost of their pollution control measures and public funds be used only in special situations; and that air pollution control as a community responsibility requires the cooperation of all concerned. Thus, all polluters are subject to certification and must meet all prescribed maximal emission regulations pertaining to dust emission, SO2 emission, and other applicable regulations. Fluorine is emitted by brick factories in quantities between 30 and 300 mg/N cu m, by cupola furnaces in quantities between 4 and 280 mg N/cu m, by Siemens-Martin furnaces in quantities between 7 and 70 mg N/cu m, by fertilizer plants in quantities between 6 and 80 mg N/cu m and by plants manufacturing insulating wool in quantities between 0.4 to 3 mg N/cu m. Guidelines regarding the required height of smoke stacks, emissions by refuse incineration plants, supervision of pollutant concentration and emission of pollutants, control of emission by boiler plants, control of olfactory pollutants and of noise pollution are outlined.

26868

Tokyo Gas Co., Ltd. (Japan), Special Demand Section

EXAMPLES OF CITY-GAS COMBUSTION IN BOILERS. (Boira ni okeru toshigasu no nenshorei). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(10):23-29, Oct. 30, 1970.

A 15 t/h boiler was revamped to compare the thermal efficiency and the automatic combustion control (ACC) operation for cases when heavy oil and natural gas are used for fuel. A complete description of the gas burner (dual fuel burner) including the tabulation of specifications, schematic diagrams, flowcharts, and operational data are presented. The operational data are given for combustion period, steam flow, vapor pressure, water supply flo rate, water supply temperature, gas flow rate, gas pressure, temperature of air entering and exiting the heat exchanger, temperature of exhaust gas entering and exiting the heat exchanger, percentage composition of exhaust gas (02 and CO2), and the outdoor temperature. The boiler efficiency is increased by a few percent using gas, and high efficiency lasts longer. Within the load variation range of 20 t/h to 5 t/h, ACC is applicable. The use of gas contributes to endurance under over-loading; at low loads, the efficiency of the boiler is much higher than when heavy oil is used There is no pollution by soot and dust and little damage to the boiler itself, water pipes, and other parts.

26277

Newton, David F.

ROLE OF THE DAIRY AND FOOD INDUSTRY IN ENVIRONMENTAL POLLUTION CONTROL. Milk Food Technol., 33(12):568-570. 4 refs. (Presente at the New York State Association of Milk and Food Sanitarians, Annual Meeting, Syracuse, N. Y., Sept. 23, 1970.)

Roles of the dairy and food industry in environmental pollution are examined in terms of a potential or actual polluter, an educator, and a community leader. Wastewater from milk houses and milking parlors and sanitary sewage from farm houses constitute potential pollutants on dairy farms, as does wastewater from milk and food processing plants in rural and urban areas. Boilers and heating facilities in milk and food processing plants are potential sources for air pollutants. Diesel trucks used to haul milk and other foods of processing plants and to retail stores are another important source of pollutants. Most supermarkets and many food warehouses have incinerators to burn combustible refuse, while dairy and poultry farms produce enormous tonnages of manure. Dairies could print statements and suggestions about pollution control on milk cartons; restaurants could have messages about pollution control printed on their place mats. Plant managers and laboratory technicians, many of whom are college graduates, possess a knowledge of science and, hence, can be very helpful to civic and conservation groups in studying and evaluating local environmental problems.

26278

NEW BOILERS MAY KEEP COAL COMPETITIVE. Chem. Eng. News, 49(3): 32-33, Jan. 11, 1971.

To keep coal competitive with other energy sources, the power industry is developing a new technology for producing steam from coal. Today's advanced conventional boilers, particularly those used to generate electric power, are very large, require field erection, and are somewhat limited in the types and forms of coal they can use. Fluidized systems offer the potential for factory fabrication of highly efficient modular units that can operate with less expensive coals. The preliminary design concept for a 300,000 pound-per-hour unit calls for the modules or cells to run parallel to the steam drum and to connect with a single carbon burn-up cell. Eight fuel injection points are called for, each serving two locations. Coal and limestone feed will be combined where sulfur dioxide controls must be employed. The primary superheaters may be arranged as baffle screens above the bed, providing an automatic control. Fly ash from the modules will be collected and fed to the carbon burn-up cell through four separate feeders. The additio of 27% pulverized limestone to the combustion zone of the fluid bed boiler permits coal with 4.5% sulfur to be burned with the effects normally experienced with coal having only 1% sulfur. A unique feature of the prototype fluid bed boiler is simultaneous total combustion of the residual carbon of the fly ash and regeneration of the limestone in an internal cell operating in parallel with the primary combustion zone. From an economic viewpoint, a factory- assembled, 250,000 pound-per-hour fluid bed boiler could be made available for about $600,000.

26538

Suzuki, Jiro

INFLUENCE OF DUST ON SO3 MEASUREMENT IN FLUE GASES. (Endo gasuchu ni okeru SO3 sokutei ni oyobosu baijin no eikyo). Text in Japanese Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku (Rept. Tech. Lab. Central Res. Inst. Elec. Power Ind.), no. 69043:1-24, Oct. 1969. 17 refs.

Sulfur trioxide was measured in a heavy oil boiler in order to understand more clearly the effects of low-oxygen combustion and th injection of additives. Sulfur dioxide and SO3 were measured by traditional methods such as JIS-K-0103. The values of SO3 showed some deviation due to the lack of standard procedures for filling u the filter. A new method of calculating SO3 quantity was based on measurements obtained by changing the packing densities and the packing length of the filter. The drawing velocity of flue gas fro an oil-fired boiler confirmed that the traditional method analyzed SO3 in the excess of 1.0 to 3.0 ppm. Thus the filling density of 0.39 g/cu cm and length over 8 cm for a dust tube filled with non-alkaline glass wool treated with HCl or quartz wool, would be appropriate. With this new sampling apparatus, the SO3 values showed a standard deviation of plus or minus 0.5 ppm.

26693

National Air Pollution Control Administration, Raleigh, N. C., Div. of Air Quality and Emission Data

NATIONWIDE INVENTORY OF AIR POLLUTANT EMISSIONS. Pub AP-73, 36p., Aug. 1970. 13 refs. NTIS: PB 196304

Nationwide emission estimates for the year 1968 are presented. Carbon monoxide, particulates, sulfur oxides, hydrocarbons, and nitrogen oxides are indicated from transportation sources, industrial processes, solid waste disposal, and fuel combustion in stationary sources. Projections of motor vehicle emissions to the year 1990 are included for HC, CO, and NOx. Presented also are the methodology and basic data used to make the emission estimates, such as fuel usage, vehicle miles of travel, and methods of solid waste disposal. Separate travel data were developed for urban and rural driving for automobiles and light- and heavy-duty trucks. Diesel fuel is indicated as well as gasoline. Aircraft, railroads, and ships are mentioned, including the non-highway consumption of motor fuels. Fuel consumption by stationary sources comprises coal, fuel oil, natural gas, and wood. Miscellaneous sources include forest fires, structural fires, coal refuse burning, organic solvent evaporation, gasoline marketing, and agricultural burning.

27471

Govan, Francis A.

CONTROL EQUIPMENT NOT ALWAYS THE ANSWER TO POLLUTION CONTROL. Bldg. Systems Design, 68(2):16, 17, 37, Feb. 1971.

In the past, the decision of whether a boiler was polluting the atmosphere was based primarily of the visible plume. Most new or proposed regulations, although still specifying visible smoke as a criterion, also incorporate particulate emission levels based on source sampling. The trend is toward more stringent levels and an accepted value of 0.2 pounds/million Btuh input appears likely. However, these new regulations do not necessarily mean that it is necessary to install air pollution control equipment. Proper adjustment, integration, operation, and maintenance of a boiler plant should keep particulate emissions within the acceptable limits.

28137

Matsumura, Yoshimi

CHEMICAL PROPERTIES OF HEAVY OIL SOOT. (Juyu nenshobai no kagakuteki seishitsu). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):190, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 10th, 1970.)

Soot in exhaust gas from a heavy-oil boiler was analyzed for acidity, water-soluble components, degree of crystallization of the carbon structure, and free-radical content. Two types of soot that were used: collected by a filter in the stack when B-heavy oil was combusted for a low-pressure sectional boiler, and that collected from the conductor surface of the boiler. Soot from heavy-oil combustion had low levels of carbonization and contained a large amount of water-soluble organic components that were very acidic. In addition, free radicals were contained in the structure of the soot.

28158

Norda, H.

SUPPLYING A POWER PLANT OF THE CHEMICAL INDUSTRY WITH LIQUID AND GASEOUS FUELS. (Versorgung eines Kraftwerkes der chemischen Industrie mit fluessigen und gasfoermigen Brennstoffen). Text in German. Mitt. Ver Grosskesselbesitzer, 51(1):23-26, Feb. 1971.

A power plant is described which comprises of two boilers with a maximum steam production of 64 tons/hr. The steam exits at 500 C. The boilers are designed for 100% gas operation, 100% oil operation, or for mixed fuels. Each boiler has four oil burners and four gas burners. The stack for the waste gas is 115 m high. Increasingly, chemical-process waste products including carbonic acid, cyan, and gas mixtures from waste-water treatment are burned in the boiler furnaces. Large quantities of hydrogen sulfide gas from a sulfuric acid plant are similarly burned. Further, waste gas which may not reach the atmosphere is burned in the boiler furnaces. Because of the variety of fuels fired in the furnaces, combustion is not always homogeneous. High fluctuations of the heating value occur. These disturbances could be eliminated.

28388

Baum, F., W. Brocke, and W. Block

DEVELOPMENT OF MEASUREMENT METHODS AND EMISSION MEASUREMENTS ON BOILER PLANTS FOR SOLID FUEL WITH NOMINAL CAPACITIES BETWEEN 18,000 AND 800,000 KCAL/HR. (Entwicklung von Messmethoden und Emissions messungen an Kesselanlagen fuer feste Brennstoffe mit Nennleistungen zwishen 18,000 kcal/hr. Text in German. Gesundh. Ingr., 92(1):12-20, Jan. 1971. 18 refs.

Measurements were made of dust emissions from 69 solid-fuel, central-heating boilers which had nominal capacities between 18,000 and 800,000 kcal/hr with the exception of six having nominal capacities of 18,500 and 20,000 kcal/hr. The measuring unit consisted of a sampling probe, a filter holding mechanism, a connection hose, and suction pump. The air sample (90 l) was drawn into the probe through an opening 9.72 mm diameter, and the dust carried by the air sample was deposited in a thimble filter. Sampling speed was 4m/sec, referred to a waste gas temperature of 320 C, and a barometric pressure of 753 mm mercury. A piston membrane pump with four entrance and four exit valves was used for drawing in the air samples. The motor of the pump switched off automatically after 10 min to maintain a constant volume intake. Boilers where the entire fuel bed burns were found emitted less dust than systems where only the bottom layer burns. The latter type emits less volatile matter, however.

28515

Ihle, Claus

WHY EXCESS PRESSURE IN THE COMBUSTION CHAMBER? (Wozu Ueberdruck im Feuerraum)? Text in German. Oel Gasfeuerung, 16(3):326-332, March 1971.

The principle of excess pressure is comming increasingly into use. A large number of boiler furnaces are now designed for the so-called excess pressure firing system, i.e., flue gas-side excess pressures of 20 to 50 mm water for cast-iron boilers and 30 to 100 mm water for steel boilers. Excess pressure boilers are more compact, require less space, and have a higher specific capacity. However, the high flue-gas speeds and the higher circumferential speed of the ventilator make them noisier than conventional boilers. In addition, the small flue-gas ducts which are necessary to obtain a high flue-gas speed make flue-gas cleaning more difficult. Finally, boiler and burner are not always tuned to each other satisfactorily.

28544

Matuo, M.

ON GAS BURNERS FOR BOILERS. (Boira gasu baana ni tsuite). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(2):20-26, Feb. 1971.

Several kinds of gas burners, automatic combustion control devices for gas-burning boilers, and safety devices for boilers are discussed. Brief descriptions of their basic mechanism are given. Two classifications of gas burners are used: the forced draft external-mix type, and the natural draft pre-mix type. The former classification is more widely used today and includes the ring-type gas burner, center-fire type, multi-lance type, center-fire type for low-pressure low-calorie gas, and scroll type. The ring type can be applied to practically all kinds of fuel gases including hydrogen city gas, and natural gas whose caloric value ranges from 2000-10,000 kcal/cu nm and gas pressure from about 0.1 to 0.5 kg/sq cm g. Like the ring type, the center-fire type finds a wide application and is used for liquid propane gas (LPG), refinery gas, natural gas, city gas, and hydrogen sulfide. A high carbon hydrogen fuel such as LPG or petroleum refinery gas is burned, mist contained in the gas is pyrolized and carbonized at the burner tip, thus damaging the burner if it is a ring-type. The multi-lance type in which the gas is jetted into the vortex air current in the burner throat through the gas ring header provided outside of the resistor is designed to avoi/ such a defect. The center-fire type for low-pressure low calorie gas, designed for combustion of blast furnace gas, formalin gas, or other waste gas containing a good deal of incombustible gases, it has a burner tip provided with several small compartments, through which gas and air are jetted alternately for speedy mixing of air with gas. The scroll type is also designed for combustion of low- calorie, low-pressure gas like blast furnace gas. Automatic combustion control devices for gas-burning boilers are introduced and safety devices are discussed, including a prepurge, pressure switch, shutoff valve, and supervisory cock.

28800

Korn, Joseph

SONIC FUEL ATOMIZATION. Heating, Piping, Air Conditioning, 43(4):84-86, April 1971.

Burners with sonic fuel atomizing nozzles are increasingly being used to reduce fuel costs while conforming to air pollution codes. Essentially, a sonic atomizing nozzle is a whistle. Gas expands through a convergent/divergent section and into a resonator cap, where it is reflected back to complement and amplify the primary shock wave. The result is an intense field of sonic energy, focused between the nozzle body and the resonator cap. By creating smaller, more uniform drops of oil and delivering them to a combustion chamber in the form of a soft mist, a sonic nozzle permits combustion conditions approaching stoichiometric to be achieved. With the basic combustion process improved, fuel consumption is reduced an average of 20%, smoke is minimized, and solid particulate emissions are cut by 80%. Combustion efficiencies of 83-87% and carbon dioxide levels of 14-16% are common even with heavy fuel oils.

29308

DEVELOPMENT TRENDS: HEATING BOILERS OF STEEL AND CAST IRON. (Entwicklungstendenzen: Heizkessel aus Stahl und Gusseisen). Text in German. Oel Gasfeuerung, 16(3):278-286, 1971.

In large cities there is a tendency to use natural gas for firing boilers in order to keep emissions low. Since this gas is difficult to ignite, ventilating burners are used which have a higher noise level. Atmospheric burners with capacities of 200,000 kcal/h are used. In small boilers of 70 mcal, the heat quantity transferred through radiation in the combustion chamber is relatively high (up to 70%), so that only small heating surfaces are needed for the transfer of heat from the flue gases after they leave the combustion chamber. Cast iron furnaces are also heated with natural gas instead of oil to curb air pollution. An increase of the waste gas temperature of 10 to 15 C was observed at boilers fired with natural gas, compared to oil-fired units.

29534

Tahara, Takeshi

COMBUSTION OF WASTE OIL FROM COAL. (Sekitankei haiyu no nensho). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(4):19-26, April 1971.

A supplemental fuel of waste oil or residual oil is used for boilers in a coal tar processing plant. Such use of the waste oil aims at fuel economy and the reduction of sulfur oxide emissions. The properties of the waste oil and how it can be effectively utilized as a fuel oil are discussed. Distillate oils from coal tar include 1% light oil, 3% carbolic oil, 13% naphthalene oil, 6% treated oil, 21% anthracene oil, and 56% pitch. The residual oils obtained after extracting the useful contents from these distillate oils are properly blended and used as the fuel oil. Characteristic of this fuel oil include a practically neutral reaction, a wide range of flashing points from 40-140 C and a varying point of fluidization. Elementary analysis reveals that the fuel oil contains more carbon but less hydrogen than petroleum heavy oil, thus giving a C/H ratio of 16 as compared to 8 for petroleum heavy oil, 0.5% or less sulfur content, and up to 5% water content. The calorific value is 10% lower than that of petroleum heavy oil. The specific gravity varies; some are heavier than water and others are lighter. The pre-combustion heating temperature depends on the viscosity, point of fluidization, and flashing point and ranges from 80 to 135 C for the oil containing a lot of pitch. Gum resins are formed and become separated when mixed with carbon in heavy oil, sometimes resulting in operational trouble. The burner tip ca be eroded or corroded with powder coke and tar acid. The blended oil from such pitch-free and highly dissolving oils produced from coal tar such as anthracene oil, treated oil, and carbolic oil blend well with carbon heavy oils at any mixing ratio. However, mixed with medium or soft pitch oil, sludge or gum resin are produced. The mixing ratios of carbon heavy oil, medium pitch, and pitch-free oil extracted from tar were studied to find the allowabl range for the blended combustion. Various aspects of combustion were also examined. Favorable results were obtained from the injection of an additive into the boiler furnace.

29538

Tada, Osamu

NITROGEN OXIDES ANALYSIS. (Chisso sankabutsu bunseki no igi). Text in Japanese. Preprint, Japan Society of Analytical Chemistry, Tokyo, 2p., 1971. (Presented at the Nitrogen Oxides Conference, 3rd, Tokyo, Japan, Jan. 22, 1971.)

A memorandum of a lecture on the significance of the analysis of nitrogen oxides is presented. It includes substances contained in the nitrogen oxides group, the generation and the source of nitrogen oxides, the influence of nitrogen oxides on the human body, and the permissible concentration of nitrogen oxides and their environmental standard. Compounds contained in the nitrogen oxides group are dinitrogen monoxide, nitrogen monoxide, nitrogen dioxide, nitrogen sesquioxide, and dinitrogen pentoxide (nitric acid). The ratio of nitrogen monoxide to nitrogen dioxide generated from the source is important. The nitrogen monoxide/nitrogen dioxide ratio is: oxyacetylene flame (0.92), carbon arc (0.91), combustion of celluloid (0.10), exhaust fume of Diesel engine (0.65), dynamite gas (0.48), and the gas generated from metals treated by nitric acid (0.22). The concentration of nitrogen oxides from several sources was reported (1961-1962): smoke from firewood stove (nitrogen dioxide; 2-9 ppm and nitrogen monoxide; 10-130 ppm), coal stove smoke (1-16 and 2-670), oil stove (0-1 and 1-7), bath gas boiler fume (1-7 and 36-118), auto exhaust gas at the outlet port (1-3 and 28-124, fume of diesel engine (420-500 and 0-35) and tobacco smoke (20-187 and 15-300). Nitrogen monoxide, nitrogen dioxide, and dinitrogen pentoxide are the objects of an argument on physical influences.

29781

Gils, Walter

MARKET DEVELOPMENT IN GAS ECONOMY. (Die Marktentwicklung in der Gaswirtschaft). Text in German. Gas Wasserfach Gas Erdgas (Munich), 112(5):215-219, May 1971. (Presented at the Gasfachlichen Aussprachetagung, Wuerzburg, West Germany, 1970.)

The natural gas consumption in West Germany in 1969 was 22.7 billion cu m/4300 kcal/cu m, an increase over the previous year of 42%. The gas supply from coking plants, remote gas supply companies, and local gas works has doubled over the past ten years. Natural gas is widely used in households and industry. Since gas heating does not contribute to air pollution, it is gaining popularity rapidly. Natural gas is also used in remote heating plants, houses, and industry (boiler plants, production plants in the cement and potassium industry, and power plants). Another further application is the total energy obtained when power is produced with the aid of a gas turbine or gas motor and where the waste heat is used for the drying processes.

30017

Joensuu, Oiva, I.

FOSSIL FUELS AS A SOURCE OF MERCURY POLLUTION. Science, 172(3987):1027-1028, June 4, 1971. 10 refs.

One suspected source of environmental mercury pollution is mercury-containing fungicides used in treatment of grain seeds. However, the amounts used are much too small to explain high mercury contents in wildlife. A large part of the mercury found in the environment is derived from industrially produced mercury, approximately 10,000 tons/yr, most of which is discarded in waste streams. Another possible source could be fossil fuels and ores. Although the concentration of mercury in fuels is small, they are consumed at an enormous rate and must be considered as a possibly significant source of mercury release. The amount of mercury in coal is not well known. To obtain a preliminary value, 36 American coals were analyzed by a mercury vapor detector. It was concluded that 3000 tons of mercury/yr are released to the environment by the burning of coal. The upper limit of mercury released by weathering is 230 tons/yr. Detailed studies are needed to determine the distribution of mercury near power plants and other users of coal.

30021

Buenz, P.

CAUSES, MEASUREMENT AND LIMITATION OF PARTICULATE EMISSION FROM OIL-FIRED STEAM BOILERS. (Ursachen, Messung und Begrenzung des Feststoffauswurfes aus oelgefeuerten Dampfkesseln). Text in German. Energie (Munich), 23(5):165-166, May 1971. 2 refs.

Three types of particulates can be determined in waste gases from oil-fired furnaces: fly ash, which is a reaction product of the non-combustible ash-forming components in the fuel; soot, which is formed through liberation of carbon during combustion in the gaseous phase; and coke from cracking processes in the liquid phase of the fuel droplets. Fly ash is produced only with heavy fuel oil. After emission, soot particles remain suspended in the atmosphere and reach the ground through a slow diffusion process. Coke particles develop through incomplete combustion. Soot flakes develop through adsorption of the particles emitted from the combustion chamber on wet surfaces. A prerequisite to these processes is a surface temperature below the dew point and the condensation of sulfuric acid from the flue gases on these surfaces. Adsorbed particulates, which form flakes having diameters of up to 5 mm, contain iron sulfate and free sulfuric acid.

30132

Chory, J. P.

THE SE-DUCT--AN IDEAL SOLUTION FOR GAS HEATERS. (Der Luft- Abgas-Schornstein - eine ideale Loesung fuer Gasfeuerstaetten). Text in German. Sanit. Heizungstech., 36(5):405-411, 1971. 4 refs.

The SE-duct is a vertical duct beginning in the basement and jutting out over the roof. In the basement, one or two horizontal ducts connect the SE-duct with the atmosphere. Through the horizontal ducts, fresh air enters the vertical duct. The gas heaters which are connected to the vertical duct have an opening in the lower section for primary air supply and another in the upper section for exit of the waste gas. The burner suitable for connection to the SE-duct must have an optimum primary air supply so that a carbon dioxide concentration of 1.5% by volume, the combustion process remains stable and clean. The burner must have excellent distribution of secondary air to reduce carbon monoxide formation and for flame control.

30829

Brown, T. D. and V. I. Hanby

HIGH INTENSITY COMBUSTION. Preprint, American Society of Mechanical Engineers, New York, Fuels Div.; Inst. of Fuel, London (England); Inst. of Combustion and Fuel Technology of Canada, Ottawa (Ontario), p. 13.1-13.25, 1970. 33 refs. (Presented at the North American Fuel Technology Conference, Ottawa, Ontario, May 31-June 3, 1970, Paper F-NAFTC-2.)

Published research on homo- and heterogeneous combustion systems indicates the importance of oxygen enrichment and temperature on combustion intensity. In the absence of those factors, the recirculation ratio is a dominant influence; in several cases, an optimum recirculation ratio exists for maximum combustion intensity. Combustion rates in heterogeneous oscillating combustion systems increase for all particle sizes as the pressure amplitude increases. Increases in combustion intensity will always lead to an increase in emissions of sulfur trioxide and oxides of nitrogen. (Author abstract)

31252

Niepenberg, H. P.

DIMENSIONS AND DESIGN FEATURES OF GAS BURNERS. (Auslegung und Konstruktionsmerkmale von Gasbrennern). Mitt. Ver. Grosskesselbesitzer, 50(1):38-44, Feb. 1970. 5 refs. Translated from German. Sanzare Assoc., Inc., Philadelphia, Pa., 22p. (Presented at the VGB Technical Convention, Gas Heating 1969, Weinburg, Germany, Nov. 14, 1969, Arnheim, Netherlands, Nov. 28, 1969, and Luebeck, Germany, Dec. 12, 1969.)

The dimensions and design features of gas burners were surveyed. For the exact layout of a gas burner, the following must be known: the gas type with respect to the gas analysis, the amount of gas to be used, the gas pressure at the burner entrance, the gas temperature, the gas moisture content, and impurities in the gas. The specific weight and the stoichiometric air requirement must be determined from the gas analysis. The common fuels for steam boilers are blast-furnace gas, coke gas, refinery gas, and natural gas. The use of the Wobbe index number to change the fuel for a given burner was described. Exhaust gases include hydrogen sulfide.

31299

Coates, N. H., P. S. Lewis, and J. W. Eckerd

COMBUSTION OF COAL IN FLUIDIZED BEDS. Trans. AIME (Am. Inst. Mining Metallurgical and Petroleum Engrs.), 247(3):208-210, Sept. 1970. (Presented at the AIME Annual Meeting, Denver, Colo., Feb. 1970.)

An eight foot fluidized combustor was operated successfully with a variety of coals, including highly caking types. The latter agglomerated when coal was fed through the side by a screw feeder, preventing satisfactory combustion. This difficulty was overcome by feeding the coal pneumatically at the bottom of the bed. Sized mullite worked well as bed material. Highest carbon utilization was about 99%. Overall heat transfer coefficients from bed to a water cooled tube were about 75 Btu/hr sq ft F. The fluidized-bed combustion system includes two centrifugal separators for removal of most of the entrained solids and a water scrubber and bag filter for further cleaning. The fluidized bed should produce less corrosion and nitrogen oxides, and permit the use of additives to control sulfur dioxide. (Author conclusions modified)

31657

Tully, R. E. and S. P. Clementson

DISTRICT HEATING CONTRIBUTES TO CLEAN AIR. Smokeless Air (London), 40(151):37-40, Autumn 1969.

A redevelopment district in London is described. District heating, with oil-fired boilers, was chosen for the entire area. The scheme provides for the installation of four packaged type boilers in the basement of a tower building. The boiler plant is designed to be fired by pressure jet oil firing units, burning fuel of 200 seconds viscosity, the draught conditions being controlled by motorized regulators. The chimney stack incorporates two flues, one for continuous use and the other for winter operation. Tapered terminals on top of the flues are designed to increase the efflux velocity to over 40 ft/sec for maximum load conditions to eliminate downwash. Smoke density indicator units are provided in the stack to work in conjunction with percentage indicators installed in the boilerhouse control panel. The application of district heating will eliminate 1500 chimney flues with their widespread air pollution. District heating will emit 40 lbs of sulfur dioxide/hr as compared to 150 lbs/hr with the existing flues. It will emit one pound of smoke/hr as compared to 3.3 lbs/hr for household grates burning smokeless fuel, or 16.6 lbs/hr if coal is burned.

32165

Gerstle, Richard W. and Timothy W. Devitt

CHLORINE AND HYDROGEN CHLORIDE EMISSIONS AND THEIR CONTROL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1971. 12 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-25.)

Chlorine and hydrogen chloride are emitted to the atmosphere by production processes and by various chemical and metallurgical processes. Hydrogen chloride is also emitted by many combustion processes using coal or fuel oil. The major uses for both chlorine and HCl are in the organic chlorination industry, which consumes almost 7.5 million tons of the chlorine and 0.9 million tons of the HCl. Economical operation of these processes requires the recovery and reuse of both chlorine and HCl whenever possible. Chlorine is emitted mainly from its manufacturing and associated handling and liquefaction processes, and in pulp bleaching. Hydrogen chloride is emitted mainly from coal and refuse combustion processes and, to a much smaller extent, from its manufacture and use. Control techniques for chlorine and HCl are well established for chemical processes and use various types of scrubbers with water or caustic as the absorbing solution. Counter-current packed towers are most commonly used to reduce emissions. The disposal of waste liquor from these scrubbers is a problem when in-plant uses cannot be found. Hydrogen chloride emissions from combustion processes are largely uncontrolled. (Author abstract modified)

32351

Lemke, Eric E., George Thomas, and Wayne E. Zwiacher

PROFILE OF AIR POLLUTION CONTROL IN LOS ANGELES COUNTY. Los Angeles County Air Pollution Control District, Calif., 66p., Jan. 1969.

A profile of air pollution sources, the effectiveness of the control program, and a projection for the future in Los Angeles are presented. The Federal Clean Air Act of 1967 figures prominently in the future projections, because it is assumed that California will set motor vehicle emission standards more stringently than the Federal standards. About 13,500 tons of air contaminants are still being emitted daily, primarily because of automobile emissions which comprise approximately 90% of the uncontrolled emissions. Major sources are listed with data on type and amounts of particulates emitted, and the amounts prevented. Motor vehicle sources include exhaust, blowby, and evaporation in gasoline-powered engines and diesel-powered engines; the prevention methods for motor vehicle emissions include crankcase and exhaust control. Other sources include organic solvents (surface coating, dry cleaning, and degreasing), chemicals (sulfur and sulfuric acid plants), incineration, non-ferrous metal production, cupolas, electric steel furnaces, open hearths, mineral production (including asphalt), and petroleum (refining, marketing, and production). Rule 62 prevents contamination from power plants and other fuel combustion processes. Jet and piston driven aircraft, ships, and railroads are also sources. Contaminants include nitrogen oxides, sulfur dioxide, carbon monoxide, hydrocarbons, and particulates. The distribution of chemical processing equipment, boilers, heaters, paint bake ovens, incinerators, metal melting equipment, concrete batch plants, petroleum processing equipment, rendering equipment, and power plant boilers are shown. Daily emissions from fuel oil, natural gas, and refinery make gas are shown. Also, steam and electric power plants are discussed. When motor vehicle exhaust reacts with the air, photochemical smog can be formed which causes eye irritation; the California Pure Air Act has set standards which should eliminate this. Stationary and mobile sources, air monitoring stations, seasonal changes, ozone concentrations, wind effects, daily concentration levels, oxidant levels, and alerts are also discussed.

33087

Sticksel, Philip R. and Richard B. Engdahl

DERIVATION OF THE EMISSION DATA AND PROJECTIONS USED IN PLANNING. In: The Federal R and D Plan for Air Pollution Control by Process Modification. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., APCO Contract CPA 22-69-147, Rept. APTD-0643, p. B-1 to B-19, Jan. 11, 1971. 11 refs. NTIS: PB 198066

The derivation of the emissions data and projections used in the five-year research and development plan for the reduction of emissions from energy-conversion combustion sources by combustion process modification are presented. The emissions include particulates, carbon monoxide, hydrocarbons, nitrogen oxides, lead, sulfur oxides, ash, and polynuclear aromatics. Sources include power plants, industry, steam generation, gas turbines, internal combustion engines, residential heating, aircraft, trucks, diesel engine, natural gas engines, and automobiles.

33640

ANNUAL REPORT 1970 BY THE ORGANIZATION OF GAS AND HEAT SUPPLY COMPANIES. (Jahresbericht 1970 des Fachverbandes der Gas- und Waermeversorgungesunternehmungen). Text in German. Gas Waerme, 25(9):157-160, Sept. 1970.

Air pollution sources, with respect to the gas and heat supply companies, are reviewed. Home heaters, contributing up to 50%, industrial combustion processes, and vehicles were the major sources. Controls for emissions from home heaters included gas as a fuel and remote heat. Natural gas combustion is smoke-free and emits no sulfur dioxide and minimum dust and soot. Boilers with remote heat usually have highly efficient filters to retain pollutant waste gas components.

33697

Wahneschaffe, E.

A STUDY OF THE CONVERSION OF SO2 TO SO3. (Ein Beitrag zur Umwandlung von SO2 zu SO3). Text in German. Mitt. Ver. Grosskesselbetr., 51(5):385-390, Oct. 1971. 11 refs. (Presented at the Vereinigung der Grosskesselbetreiber, Fachtagung, Emissionen 1971, Hannover, West Germany, Feb. 19, 1971, Munich, West Germany, March 5, 1971, and Essen, West Germany, March 19, 1971.)

The conversion of sulfur dioxide to sulfur trioxide during the combustion of sulfur-containing fuels and subsequent reactions with other components of waste gases in the boiler are examined. The combustion of fuel oils and other fuels produces carbon dioxide, carbon monoxide, SO3, SO2, nitrogen, oxygen, and nitrogen oxides. The nitrogen oxide (nitrogen dioxide and nitric oxide) concentration increases with increasing boiler load. Between 600 and 900 C, the 10% increase of the SO3 content is due to a direct reaction between SO2 and NO2. Between 300 and 600 C, volatile nitrogen-sulfur compounds develop, liberating SO2 from SO3; the compounds leave with the other waste gas components without condensation. The temperature range below 300 C is characterized by an increase in SO3 concentration, directly correlated with the NO2 content of the flue gas. The conversion of SO2 outside the stacks is largely dependent on the presence and concentration of NOx in the waste gases; the conversion of NO to NO2 determines the speed of the reactions.

34303

Macey, H. H.

THE MEMORANDUM ON CHIMNEY HEIGHTS AND MODERN OIL-FIRED BOILERS. Clean Air (J. Clean Air Soc. Australia New Zealand), 5(3):49-52, Aug. 1971. 5 refs.

A simple correction is suggested to heights determined from the Memorandum on Chimney Heights, first published by the United Kingdom Ministry of Housing and Local Government in 1963 and revised in 1967. Application of the correction will give the original acceptable ground level sulfur dioxide concentration for modern boilers, which require less excess air than those for which the Memorandum was designed, and for which the plume rises are smaller. After obtaining a height from the Memorandum in the usual way, thy height should be further increased by a percentage which is numerically equal to that height in feet divided by ten.

B. CONTROL METHODS

00107

S. S. Griswold

CONTROL OF STATIONARY SOURCES (TECHNICAL PROGRESS REPT. VOLUME 1). Los Angeles County Air Pollution Control District, Calif. Apr. 1960. 191 pp.

As a result of the intensive source control measures administered in Los Angeles County, Virtually all industrial operations have been brought within the scope of the air pollution control program. From the melting of metal to the painting of manufactured goods, specific industrial processes and equipment have been subject to air pollution control measures. This volume provides individual discussion of control techniques applied to the most significant stationary sources of air contamination. Certain source emission problems, such as those traceable to the operation of railroad locomotives and ships, are not discussed in this volume in view of the current unimportance of the source. The material reported in this volume generally contains only those developments occurring subsequent to the publication of the Second Technical and Administrative Report on Air Pollution Control in Los Angeles County, 1950-51. (Author)

00140

J. H. Fernandes, J. D. Sensenbaugh, and D. G. Peterson

BOILER EMISSIONS AND THEIR CONTROL. Combustion Engineering, Inc., Windsor, Conn., and Air Preheater Co., Wellsville, N.Y. (Presented at Conference on Air Pollution Control, Mexico City, Apr. 28, 1966.)

Emissions from combustion sources that are significant from the standpoint of air pollution include (1) particulate matter, (2) sulfur oxides, and (3) nitrogen oxides. Particulate matter is objectionable on esthetic grounds. The technology for its control well developed, although effort is constantly being made to improve collection equipment and reduce the cost of a nonproductive operation. Techniques have been developed for control of SO3 in oil-fired units by means of low-excess air and additives. Methods for control of SO3 in coal-fired boilers have not been as well developed as for oil-fired units, but there is less SO3 present with coal firing. A great deal of work has been done on control of SO2, both by fuel desulfurization and by removing the SO2 from the stack gas. Oxides of nitrogen are important as air pollutants because of their participation in the reactions leading to photochemical smog. Since the localities most subject to photochemical smog are in oil and gas burning areas, most of the work has been done on these fuels. The emission of oxides of nitrogen can be significantly reduced by using gas fuel or by use of a suitable firing method and low-excess air with oil fuel.

00272

N. Glensy

MECHANICAL HANDLING OF COAL AND ASH. Eng. Boiler House Rev. (London), 81(6):170-177, June 1966.

Principal systems now available for coal and ash handling in small and medium-sized boiler houses are reviewed. Handling systems for the solid fuel and arrangements for extraction and disposal of ash are vital elements in the automatic operation of coal-fired industrial process boilers. Equipment suitable for removing ash are submerged conveyors, vibratory conveyors and pnrumatic handling plants. Submerged conveyors or draglink conveyors are widely used in large installations because they require little maintenance and have the advantage of being completely dust free. Systems can be designed to handle loads within the range from three-quarters of a ton to 20 ton/hr.

00287

R. E. Barrett, J. D. Hummell, and W. T. Reid

FORMATION OF SO3 IN A NONCATALYTIC COMBUSTOR. J. Eng. Power. 1965. 7 pp. (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, Chicago, Ill., Nov. 7-11, 1965.)

The major contributor to corrosion and deposits in boilers and gas turbines has been recognized as the reaction of sulfur oxides, especially SO3, in the combustion gas with furnace elements. One way to minimize these reactions is to reduce the quantity of SO3 formed. Factors affecting SO3 formation have been studied in a noncatalytic laboratory combustor, and results of the investigation show that SO3 in the combustion gas can be reduced by: (a) Reducing excess air, (b) burning fuel with a lower sulfur content, (c) preventing air leakage into the combustion system, and (d) covering catalytic surfaces, such as superheater tubes, with less catalytic protective coatings. Some experiments showed that iwon-oxide coatings, which built up on iron surfaces, were highly catalytic for the production of SO3 under boiler-furnace-simulated conditions. (Authors' abstract)

00406

S.A. Burke K.E. Collins

THE PERFORMANCE OF THE B.C.U.R.A. FULLY-AUTOMATIC SMOKELESS STOXER FOR CENTRAL HEATING. J. Inst. Heating Ventilating Engrs. (London) Vol. 34:114-28, July 1966.

Performance of a new type of chain grate stoker is described. The boiler heating efficiency (combustion and heat transfer to water in the boiler) was 73% at full firing rate and 81% at 1/20 of full rating. Development of a new air-cooled ignition arch raised these efficiencies to 78% and 85% respectively. Smoke emission is extremely low: the optical density is less than 0.01. The high degree of smokelessness is maintained despite changes in coal characteristics. Total grit and dust emission was 0.19% of the weight of the coal fired, nearly half of which is recovered from a cyclone.

00716

L. Alliot M. Auclair

EXPERIMENTS ON COMBUSTION OF DOMESTIC FUEL IN AN EXPERIMENTAL BOILER. (Essais de Combustion de Fuel Domestique sur Chaudiere Experimentale.) Rev. Inst. Franc. Petrole Ann. Combust. Liquides (Paris) 20(11):1757-1772, Nov. 1965.

The influence of the flow of combustible on the quantity of solid incombustible particles was studied using standard equipment and a light domestic fuel oil with an average composition of 50% paraffins, 20% olefins and 30% aromatics. A mechanical smoke extractor was installed one meter from the spray nozzle for sampling of the gases. Rates of fuel consumption were varied, and continous fuel flow was compared with intermittent fuel flow. When the supply of combustible fuel exceeded the capacity of the burner, proper combustion was not obtained and the solid particles increased. If the flow of air was decreased, the Bacharach index (measuring the opacity of the effluent gas) rose, and the yield of utilizable heat increased only 3-4%. When fuel flow was properly adjusted to the capacity of the boiler, no smoke at all was noticed. 00716 L. Alliot M. Auclair

00717

A. Labardin F. Mauss

INFLUENCE OF BURNER FUNCTION ON THE EMISSION OF SOLID PARTICLES. (Influence du Fonctionnement des Bruleurs sur les Emissions de Particules Solides.) Rev. Inst. Franc. Petrole Ann. Combust. Liquides (Paris) 20(11):1771-1783, Nov. 1965.

Two methods of measuring solid particles were employed, first the impinger method, and second the cyclone plus filter method (the so-called 'B.P' apparatus). The second method consistently gave higher results. The index of solid particles was expressed as a weight, or grams per therm. In these experiments, three different types of air regulators were used in standard equipment at a constant fuel supply of 10.4 kg per hour in a boiler of 140 therms/hour capacity. The weight of solid particles and smoke emitted did not depend on the type of flame or air regulator, but on whether air was supplied in excess, particulary when the excess of air was over 70%. When discontinuous operation was tried (10 minutes on and 10 minutes off), emission of solid particles under conditions equivalent to continuous operation was slightly higher.

01459

G. Nonhebel

BRITISH CHARTS FOR HEIGHTS OF INDUSTRIAL CHIMNEYS. Intern. J. Air Water Pollution, Vol. 10:183-189, 1966.

A precis is given of the Memorandum on Chimney Heights issued by the British Ministry of Housing and Local Government in 1963. The purpose of the Memorandum is to assist local authorities to determine the minimum acceptable height for new chimneys for industrial plant not coming under the jurisdiction of the Alkali Instpecorate, and for SO2 emissions from 3 to 1800 lb/hr. Examples are given of charts relating height of chimney with SO2 emission rate and for additional height required when downdraught from adjacent buildings is to be expected. The basic height of chimneys for oil-fired plant is 10 per cent higher than for coal-fired plant. Minimum effluent velocities are stated. 0otes are given of the technical work leading to the Memorandum. The average maximum ground-level concentration of SO2 from the recommended heights is 16 pphm by volume (0.45 mg/N cum) for 3-min sampling time when calculated from the Bosanquet-Sutton equations. Some account is taken of contaminants other than SO2. The assistance given by the Memorandum has been widely praised by local authorities after two years' experience. (Author abstract)

01496

M. Beaumont

MULTIPLE FLUE CHIMNEYS. J. Inst. Fuel (London) 39(301):78-83, Feb. 1966.

This paper deals with the progress made in the development of the design of industrial chimneys over the past ten years. It explains that, because aluminum insulating cladding, which was first used in 1956, does not always prove effective in preventing smuts from forming other methods had to be found. The great problem is that when more than one boiler is connected to a common chimney, the chimney has to be designed to accommodate the flue gases of all the boilers on full load at the same time. Consequently when some of the boilers are off-load or on turndown, the flue-gas velocity is reduced and smuts may be formed. Various ways of overcoming this problem were tried; plain dividing plates, insulating dividing plates, concentric chimneys, chimneys supported in concrete or steel structures, insulated chimneys and finally the multi-flue insulated chimney. The latter, by providing each boiler with its own correctly sized flue, appears to have overcome the difficulties of fluctuating boiler load and flue-gas velocity. (Author abstract)

01626

C. H. Pesterfield

LITERATURE AND RESEARCH SURVEY TO DETERMINE NECESSITY AND FEASIBILITY OF AIR POLLUTION RESEARCH PROJECT ON COMBUSTION OF COMMERCIALLY AVAILABLE FUEL OILS. J. Air Pollution Control Assoc. 14, (6) 203-7, June 1964. (TA-4 Committee, Oil Burner Equipment.)

The basic purpose of this preliminary survey was to determine: (a) whether the combustion of fuel oil presented a serious air pollution problem by nature of its being a serious pollutant contributor; (b) what work has been done to evaluate its pollution contribution; (c) what work is being done; (d) what needs to be done; (e) if there is need and justification for a fuel oil combustion study.

02030

S. Maartman

COLLECTION OF DUST FROM OIL-FIRED BOILERS IN MULTI-CYCLONES AND ELECTROSTATIC PRECIPITATORS. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper V/6). pp. 131-3.

Since the Second World War and particularly since 1955 oil has become the predominant fuel in Sweden. Most boilers are equipped with mechanical dust collectors of multi-cyclone type, although in normal operation the outgoing dust concentration is only approximately 200 mg/cu.mN. However, this dust has properties that make a reduction to less than 40 mg/cu.mN desirable. Paraclone multi-cyclones have a collecting efficiency of 85 per cent in normal operation and 90 per cent during soot blowing. Some 200 installations handling a total gas volume of about 15 million cu.m/hr. are in service in various countries. Very favourable experience has been gained with electrostatic precipitators installed in conjunction with oil-fired boilers at the Hasselby Power Station near Stockholm. A new 490-ton boiler at this station will be equipped with a precipitator designed for a released dust concentration of 30 mg/cu.m.N during normal operation and soot blowing. Demands for cleaner air are expected to result in increasing use of dust collectors in conjunction with oil-fired boilers. (Author abstract)

02032

K. Schwarz

(DUST EMISSIONS FROM COAL-FIRED BOILERS IN THE FEDERAL REPUBLIC OF GERMANY.) Die Staubemissionen Kohlegefeuerte Dampfkesselgrossanlagen in Der Bundesrepublik

Deutschland. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper V/8). pp. 136-41.

In the Federal Republic of Germany, rigorous scales were evolved for the supervision of emissions from industrial plants by the Federal Regulations issued in 1959 in the interests of clean air, and by the technical regulations of 1964, which set limits for these ('Technical Directions for Clean Air, TAL'). This applies in particular for the requirements which were placed on the emission of dust from large coal-fired boilers particularly when the fuel has a high ash content. Results of numerous experiments on large, electric dust removers for bituminous coal and brown coal-fired boilers - carried out by the Technical Supervisor Groups in Essen and the Rheinland, show the developments over the past few years towards ever higher separating achievements. Effects of various factors, in particular the properties of the fuel and the combustion conditions , were visible on dust properties and separating results. The limits reached today in this sector are indicated. (Author abstract) 02032 K. Schwarz

02973

G. Schiemann

REDUCING THE EMISSION OF SMALL OIL-FIRING UNITS WITH SPECIAL EMPHASIS ON CONTROL METHODS. Staub (English Transl.) 25, (11) 2-10, NOV. 1965. CFSTI TT 66-51040/11

In the case of small oil firing installations the type and concentration of emissions depend on the combustion process. Noxious effects are mainly caused by soot and aromatic hydrocarbons. Investigations into the possibility of reducing these emissions show that the most convenient solution of the problem is as complete a combustion of all combustible emission components as possible. Practical experience indicates that the present technical methods permit improvements to be achieved. Control methods used in heating operations are here of particular importance because of their effects on combustion. (Author summary)

03045

H. Mori

HANSHIN WET TYPE DUST COLLECTORS. Clean Air Heat Management (Tokyo) 15, (5) 5-11, May 1966

There are three models of Hanshin Wet Type Dust Collectors for collecting different kinds of dust and they all operate on the same principles. Contaminated exhaust gas is forced into a water tank equipped with turbulance control plates through nozzles at a high speed. The gas is cleaned while in contact with the water. The HJ model is for collecting fine particles from such materials as sand, cement, activated carbon and brick. The typical collection efficiency for various particle size distributions is approximately 99%. The HJS model is designed for use with oil and coal burners. The mechanics of this model are the same for the HJ models, but the HJS model requires the addition of a sludge tank. The concentration of soot in the exhaust gas is reduced by a factor of two. Appropriate sizes of HJS models for different boiler sizes are tabulated. HJG models are designed for the treatment of gaseous contamination in exhaust gas. They have the same structure as HJ and HJS models except that a de-mister is added at the top of the tank. The absorption efficiencies for H2S, Cl2, SO2 and NO2 are tabulated. The efficiency of 98.5% is obtained for H2S by addition of NaOH to the tank water.

03053

G. A. W. Van Doornum.

SMOKELESS COMBUSTION OF BITUMINOUS COAL. Coal, Gold, and Base Minerals of S. Africa 14, (7) 32-3, 37, Sept. 1966.

Smokeless combustion of bituminous coal is possible in small industrial furnaces, boilers and domestic installations. In order to burn the tar fumes resulting from the primary decomposition of coal, a secondary source of oxygen must be mixed thoroughly with the fumes and the combustion temperature must be at least 700C. Two examples of methods for achieving this are discussed. One consists of a combustion chamber which can be incorporated into a variety of appliances; the other involves the use of a nozzle to produce a tangential air-jet in a hand-fired vertical boiler.

03121

K. Lenhart, K. Schwarz

METHODS OF REDUCING POLLUTION CAUSED BY COMBUSTION. (Domestic & Industrial). European Conf. on Air Pollution, Strasoourg, 1964. p. 165-190.

The report refers to the problems of air pollution by flue gases resulting from the combustion of solid, liquid, and gaseous fuels. Domestic fireplaces as well as industrial furnaces are included. The latter are considered only in so far as their flue gases consist of the products or residues of the combustion of fuel. Industrial furnaces, the flue gases of which come into direct contact with manufacturer products and may be contaminated by them - e.g. cement kilns, shaft lime kilns, cupolas and others - are, therefore, not included in the study. In spite of this limitation the subject is still so comprehensive as to make it seem desirable to evaluate the reports received from eleven countries with carying economic structures in two separate sections - one referring to domestic and the other to industrial consumption.

03153

P. F. Drake and E. H. Hubbard

COMBUSTION SYSTEM AERODYNAMICS AND THEIR EFFECT ON THE BURNING OF HEAVY FUEL OIL. J. Inst. Fuel (London) (Presented at the Meeting of The Institute, London, Jan. 26, 1966.) Mar. 1966. pp. 98-109.

An investigation has been made into the reasons for the large variations in quantity and type of gas-borne solid carbon emitted from an oil-fired water-tube boiler at varying levels of rotational energy in the combustion air. The changes in fuel-air mixing both in the air register and in the combustion chamber have been related to the gas-borne solids burden and the interrelation between fuel-air mixing and spatial distribution of the fuel has also been studied. It is shown that a pronounced optimum occurs in carbon burn-out at an intermediate level of rotational energy. This optimum appears to be achieved when the position of maximum recirculation is nearest to the burner and is followed by a region approximating to plug flow. The character of the solids produced at either side of the optimum condition differs considerably. Variation of oil spray angle appears to be of secondary importance if the air conditions are at the optimum. (Author abstract)

03223

ADDITIVES FOR FUELS USED IN FIXED COMBUSTION CHAMBERS. Les additifs pour combustibies Utilises dans les foyer fixes. Text in French. Pollut. Atmos (Paris) 8, 931) 295-318, Sept. 1966

Studies by the Center for Interdisciplinary Technical Study of Atmospheric Pollution concerning additives used for improving combustion or having a beneficial effect on the discharge of undesirable compounds into the atmosphere, or both, are reviewed. The paper summarizes the study of some additives, starting with those of known chemical composition, the actions claimed for the additives, the results that can be expected from their use, and the test methods and results using small and medium size boilers with liquid fuels and the additives ammonia and magnesium oxide. The following additives are covered in the study: ammonia, dolamite (Calcium magnesium carbonate), magnesium oxide, metallic magnesium, and zinc powder. Seven graphs pertinent to the experimental procedures also are given. (Atuhor summary)

03790

W. H. Axtman

HEAVY OILBURNERS AND AIR POLLUTION. Fuel Oil, Oil Heat 26, (1) 61-4, Jan. 1967.

Smoke is a suspension of solid particles and these particles result from incomplete combustion. Unburned fuel is going up the stack; going up in smoke in fact. All installations, domestic as well as commercial industrial, should be set with combustion testing instruments. Combustion and smoke tests can prove the smoke source. For cleaner oilheating, the following must be considered: 1. Combustion chamber condition and design. 2. Oil temperature and preheating. 3. Grade of oil vs. firing rate and type of operation. 4. Condition of burner and atmoizing system. 5. Draft and draft controls. 6. Combustion control systems. 7. Burner modulation and low fire start controls. 8. Fuel storage and pump sets. 9. Condition of boiler. 10. Boiler design for oil firing. Present methods of removing sulphur from fuel oils are expensive. In some instances, a change can be made to a lighter grade oil, particularly in smaller firing rates where No. 5 or No. 6 should not have been used, or provision can be made for a switch to alternate grades during times of possible air pollution emergencies. Much of our oil comes from areas outside the United States, and a loss in the heavy oil gallonage could have world wide implications.

04304

W. Reid

NEW HORIZONS IN DOMESTIC HEATING - SOLID FUEL. Proc. Clean Air Conf., 32nd, Eastbourne, Engl., 1965. pp. 125-34.

The paper shows the direction in which the solid fuel industry is meeting the modern requirements of greater comfort at low cost, more efficient combustion and, therefore, a cleaner atmosphere. In this context the industry has developed smokeless fuels and is increasing productivity of these to meet the rising demand. It has collaborated with the appliance manufacturers to produce new attractive, efficient and as near as possible automatic appliances. Perhaps the most recent important development is in the direction of district heating. The paper describes in some detail the first comprehensive district heating scheme to serve multi-storey residential flats, the town's centre and cultural and educational facilities as well as adjacent light industry. (Author abstract)

04336

B. C. Severs

THE ABC'S OF FIRESIDE CORROSION. Proc. Am. Power Conf. 27, 864-7, Apr. 1965. (Presented at the 27th Annual Meeting, American Power Conference, Chicago, Ill., Apr. 27-29, 1965.)

The ABC' of fireside corrosion are recognition of the characteristics of gas side corrosion, the acceptance of certain defined corrosion limits and the knowledge that boilers can be designed with controlled gas temperatures, proper disposition of surfaces and good distribution of both gas and steam to produce a dependable, efficient and economical product. During combustion, most of the sulfur in the fuel burns to sulfur dioxide (SO2) with a small part forming sulfur trioxide (SO3). The SO3 combines with water to form sulfuric acid vapor. Sulfuric acid vapor has a dew point above that of water and causes condensation to occur at a higher level. If the temperature of the metals in contact with the gases falls below the dew point, sulfuric acid condenses and acid corrosion results. Low-temperature corrosion on coalfired boilers is accompanied by ash deposition and plugging. Flyash and cinder particles act as condensation nuclei for sulfuric acid vapor, become wet, and stick to economizer and airheater surfaces. Acid will react with flyash in the cooler areas of gas flues and casing to form hygroscopic salts, such as ferrous sulfate, aluminum sulfate and bisulfates of sodium and promote corrosion. In oil-fired boilers the corrosion resulting from the formation and condensation of sulfuric acid from flue gas is similar to that of coal-fired boilers. However, oilfired boilers are more suceptible to low-temperature corrosion than are coal-fired units for two reasons: (1) Vanadium in the oil ash is a catalyst for the conversion of SO2 to SO3, and (2) The smaller quantity of ash in the gas stream is a factor contributing to the difference. Ash particles in the gas stream can absorb SO3 and reduce the amount of free SO3 vapor in the flue gas, and the basic nature of coal ash tends to neutralize a portion of the acid deposited. Additives such as magnesium oxide and dolomite have been used on oil and coal-fired units to inhibit high-temperature corrosion. These additives are injected with the fuel, directly into the furnace, or into the combustion air stream.

04358

S. Student

(CORRECT USE OF RECORDINGS IN SMALL BOILER-HOUSES½) Registrieren auch im kleinen Kesselhaus, aber richtig½ Brennstoff-Waerme-Kraft (Duesseldorf) 17, (5) 248-9, May 1965. Ger.

Steam generators of low capacity, about 2.5 to 25 t/h are constructed in great numbers. They hardly ever pose technical problems and are rarely mentioned in the literature. These generators are equipped with control devices and the majority register measurement values. Some of these recorders are rendered useless because of the arrangement of the recording scale. For the control of operation of boilers these recordings can be of great value. A measurement and control device is suggested for smaller operations. A single recording instrument of a boiler which records continuously besides the steam flow also steam pressure, carbon dioxide and unburned carbon monoxide is discussed. These values are very sensitive to changes occurring in the operation and the attention of the operator will be called by its registration on the well organized scale. Author describes operation of a recording instrument using different colors to facilitate readings for steam flow, steam pressure, carbon dioxide and unburned smoke gases.

04372

SIMPLER CONTROL OF LOW EXCESS AIR. Power 109, (5) 65, May 1965.

A Hartman and Braun CO recording machine was installed. Its operation is based on the difference in absorption of light from an infrared source by CO in a sample of flue gas and by nitrogen contained in similar chambers which are separated by a membrane. Temperature difference on two sides of the membrane causes it to deflect. This motion translated into electric impulse in a capacitor, indicates the CO content. An opacity smoke meter detects a dense white mist of SO3 whenever excess air goes above the 1% limit. Three years of low excess air operation resulted in cleaner boilers and air heaters, and less corrosion.

04394

K. Darby and D. O. Heinrich

CONDITIONING OF BOILER FLUE GASES FOR IMPROVING EFFICIENCY OF ELECTROFILTERS. STAUB (English Transl.) (Duesseldorf) 26, (11) 12-7, Nov. 1966. Ger. (Tr.)

Several operating conditions of electrofilters which operate with a reduced effective power input can be substantially improved by the injection of small quantities of SO3 into the fluegas. Measurements on full scale plants have shown that the effective migration velocities have increased by up to 85%. An SO3 conditioning plant, now working for more than two years, has proved that there is no increase in sulphur emission and no additional corrosion problem. (Author summary)

04516

R. E. George and R. L. Chass

CONTROL OF CONTAMINANT EMISSION FROM FOSSIL FUEL-FIRED BOILERS. J. Air Pollution Control Assoc. 17, (6) 392-5, June 1967. (Presented at the 151st National Meeting, American Chemical Society, Symposium on Fossil Fuels and Environmental Pol- lution, Pittsburgh, Pa., Mar. 22-25, 1966.)

The topics covered include: air pollution from combustion sources control of combustion; a case study of Los Angeles County vs. New York City; and power plant control in Los Angeles County.

04856

E. Z. Finfer

FUEL OIL ADDITIVES FOR CONTROLLING AIR CONTAMINANT EMISSIONS. J Air Pollution Control Assoc. 17, (1) 43-5, Jan. 1967.

An addition of additives to fuel oils prior to combustion is one way of reducing combustible contaminant emissions to the outer air. Reported test results show that some additives improve, moderately, the combustive properties of fuel oils. Combustion is also improved but to a lesser degree, in boiler systems that are deficient in operation and design. Being combustible, polynuclear hydrocarbons emissions would be reduced by use of additives. Other types of additives to reduce slagging and inhibit corrosion from combustion of fuel oils are also available. The cost of using additives is low. Improved additives are required, especially ones to better combustion in the deficient boiler systems. These can be found by research and literature surveys. Their effectiveness and nontoxicity would be confirmed by laboratory and field testing. (Author abstract)

04862

F. Petersen

AGGRESSIVE SOOT -- A SERIOUS CORROSION PROBLEM. VVS (J. Assoc. Heating, Ventilation, Sanit. Engrs.) (Stockholm (1) 19-23, 1968. Translated from Swedish.

A review is presented of the corrosiveness of soot particles, conventional protection methods, the process of soot formation, the formation of sulfuric acid, adsorption by soot particles, suppression of floc cormation, and practical tests conducted at Tekniska Hogskolan in Stockholm. An improvement is advanced: an increase of the boiler water temperature when heating with heavy oils appears to be justified. The increase should be up to 150 degrees C for the adsorption of aggressive substances on soot particles to be adequately suppressed. The proposed increase should result in reduced damage to protective coatings, automobile lacquers, ladies' stockings, and clothing were aggressive soot flocs easily produce point attacks. In addition the corrosion on the fireside surfaces of the heating boilers will be substantially reduced.

05137

F. Johnswich

DESULFURIZATION OF FLUE GASES. VIK Berichte (155) 20-43, Aug. 1964. Ger. (Tr.)

The method for the desulfurization of flue gases according to the dolomite procedure was investigated with the help of a 175 t/hr oil boiler. The factor that was decisive for desulfurization was the temperature that prevailed in the boiler at the place where the desulfurization material is inserted. The effect of the distribution, the duration of time (in the boiler), the effect of the catalyst and of the volume of the material to be used were of secondary importance. It is understood on the basis of the description of the experimental results, that these results for the time being apply only to the experimental boiler. Some of the basic problems could not be resolved and new basic problems arose; these problems must be answered for the purpose of planning and giving a guarantee in connection with the erection of a desulfurization installation. Additional series of experiments are necessary before the method is ready for actual operation. (Author summary modified)

05347

Campbell, O. F. and Pennels, N. E.

CO BOILER AND FLUIDIZED-BED STEAM SUPERHEATER ON SINCLAIR REFINING COMPANY'S NEW FLUID UNIT AT THE HOUSTON REFINERY. American Soc- iety of Mechanical Engineers, New York 77, 927-38 (Aug. 1955). (Presented at the Annual Meeting, American Society of Mechan- ical Engineers, New York City, Nov. 28-Dec. 3, 1954, Paper No. 54-A-20.)

Approximately 400,000 lb per hr of 550-psig, 750 F total temperature steam production is a unique feature of Sinclair Refining Company's new fluid catalytic-cracking unit at its Houston, Texas, Refinery. Over 300,000 lb per hr of 700-psig saturated steam are produced on the oil industry's first direct-fired unit to recover both the sensible heat and the heat of combustion from the high-temperature regenerator-exit flue gas. The heat of combustion of the regenerator-exit flue gas is derived from its CO content. Saturated steam produced on the boiler is superheated to 750 F total temperature in industry's first fluidized-bed respray steam superheater. The superheater-respray feature produces approximately 100,000 lb per hr of additional steam and allows simultaneous control of both the regenerator-bed temperature and the steam superheat. Other advantages are: prevents the CO gas from escaping and possible pollution of the atmosphere; precludes the possibility of unburned hydrocarbons or malodorous gases, or other gases that may cause air pollution, from escaping to the atmosphere; and conditions the flue gases for subsequent removal of particulate matter.

05393

W. Strewe

HEAT PRODUCTION FROM SOLID FUELS. Waermeerzeugung mit festen Brennstoffen. Gesundh. Ingr. (Munich) 86 (4), 111-6 (Apr. 1965). Ger.

Problems associated with air pollution by solid particles and combustion gases generated in various types of solid fuel furnaces examined. Means of dust elimination that can be applied to the fuel itself as well as to the fuel charger, fire box, boiler construction and firing technique are critically reviewed. Various types of dust arresting installations are described.

05429

H. Anders

COMPOSITION AND ANALYSIS OF BOILER FLUE GASES. (Uber die Zusammensetzung und Untersuchung der Kesselabgase.) Zucker, 20(3):68-70, Feb. 1, 1967. Ger.

In order to ensure most economical operation of a boiler, the air supply must be closely controlled. Sampling the flue gases and measuring their contents of CO2, CO, and O2 gives information on the efficiency of the boiler operation. The conventional method of gas analysis by absorption in potassium hydroxide, pyrogallic acid, and cuprous chloride solution (Orsat Apparatus) is described as well as the method of resistance measurement of a heated wire.

05517

I. McC. Stewart

SOLID FUEL FIRING OF SMALL INDUSTRIAL BOILERS IN THE 'CLEAN AIR' AGE. Proc. Clean Air Conf., Univ. New South Wales, 1962, Paper 23, Vol. 2, 16 p.

The paper outlines the properties of fuels available in New South Wales Metropolitan areas for industrial steam raising showing that an adequate range of properties and sizings is available to provide satisfactory fuel for all commercial equipment. The importance of adequate draft control is stressed by analysis of fuel bed performance under changing lead conditions. Instruments and simple automatic controllers are briefly reviewed and also the particular characteristics of common types of firing equipment with regard to prevention of pollution. A brief note on impressions of stoker development in Europe is included. (Author abstract)

05853

C. R. Flodin and H. H. Haaland

SOME FACTORS AFFECTING FLY-ASH COLLECTOR PERFORMANCE ON LARGE PULVERIZED FUEL-FIRED BOILERS. Air Repair 5(1), 27-32 (May 1955). (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 28-Dec. 3, 1954.) 05857 D. H. Barnhart and E. K. Diehl CONTROL OF NITROGEN OXIDES IN BOILER FLUE GASES BY TWO-STAGE COMBUSTION. J. Air Pollution Control Assoc. 10 (5), 397-406 (Oct. 1960). (Presente at the 52nd Annual Meeting, Air Pollution Control Association, Los Angeles, Calif., June 21-26, 1959.)

Two-Stage Combustion with auxiliary-air ports above the burners is an effective method for controlling the nitric oxide concentration in boiler flue gases while still maintaining acceptable boiler performance. While utilizing this method of operation, with 95% of the combustion air through the burners, the nitric oxide level was reduced nearly 30% with both oil and gas firing. A reduction of 47% occurred during full-load oil firing when the air flow through the burners was 90%. The principal gains made in bringing nitric oxide under control are summarized. Two-Stage Combustion together with monor changes to the burner (approach-cone vanes out and air registers wide open) has given a total nitric oxide reduction of 56% when firing oil at full load. As mentioned previously, similar results can be expected in gas firing. It appears that additional reductions in nitric oxide would be possible if the air flow through the burners were reduced another 5 or 10%. The limit would be reached when combustibles (carbon, CO, etc.) were detected at the furnace outlet, or when the burners became unstable. The Southern California Edison Company put the Two-Stage Combustion Method into extended test operation at their El Segundo Steam Station. Although the fuel-air mixing process requires careful balance between rapid mixing for best combustion, and delayed mixing for nitric oxide reduction, the change has not required expensive equipment nor has it involved any extensive alterations to the boiler. This method of burning has also been incorporated in the design of two new boilers for Edison's Mandalay Station and two for their Huntington Beach Station. Two-Stage Combustion is believed to be a practical operating method for the control of nitric oxide emission from large gas- or oil-fired boilers. (Author summary modified)

05868

H. J. White

EFFECT OF FLYASH CHARACTERISTICS ON COLLECTOR PERFORMANCE. Air Repair 5 (1), 37-50, 62 (May 1955). (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 28-Dec. 3, 1954.)

The primary objectives were to describe the important properties of fly ash; to indicate the dependence of these properties on such factors as coal burned and furnace design and operation; to show the intimate relationship between fly ash characteristics and collector performance, to bring out the principles and methods used in precipitator design and operation to overcome adverse characteristics of fly ash; and to indicate future trends and advances which may be expected in this field. Collector performance is greatly influenced by the diverse physical and chemical characteristics of fly ash encountered in practice. The ash characteristics are measurable, but for projected boilers (which form the large majority of collector installations) are not in most cases accurately predictable. This complicates collector design and in some cases necessitates extensive changes in collector equipment after construction in order to meet unusually adverse ash characteristics. In general, conservative design is indicated, since collectors are expected to perform satisfactorily for whatever type of ash may happen to occur.

06548

Council for Scientific and Industrial Research Pretoria (South Africa) Air Pollution Research Group.

HOW TO OBTAIN HIGH STEAMING RATES FROM VERTICAL BOILERS FIRED WITH ANTHRACITE. (Rept. CSIR 249.) (1966). 11 pp.

Simple modifications are described, which were made to a vertical boiler installation in an effort to find whether a high steaming rate was possible using anthracite instead of bituminous coal with the object of reducing smoke production. A complete energy balance for the boiler was obtained in the experiments. The three most important parameters involved are considered and discussed: the velocity of the stack gas, the overall efficiency of the boiler, and the steam-raising capacity of the boiler. Recommendations for the adaptation of industrial vertical boilers so that they can be used with anthracite, are made. Small vertical boilers can be operated successfully on anthracite if the draught is increased so as to make the stack-gas flow rate approximately the same as when bituminous coal is used. This increase in draught can be obtained by: (a) installing a forced-draught fan, or (b) increasing the height of the stack.

06562

RESTRICTING DUST EMISSION FROM FORCED-DRAFT BOILER INSTALLATIONS, CAPACITY 10 TON/HR AND OVER, HARD-COAL FIRED WITH MECHANICAL GRATES. (Staubauswurfbegrenzung Dampfkessel uber 10 t/h Leistung Steinkohlenfeuerungen mit Unterwind-Zonenwanderrost.) VDI (Verein Deutscher Ingenieure) Kommission Reinhaltung der Luft, Duesseldorf, Germany. (Nov. 1961). Ger. (Tr.) 27 pp. (VDI 2091.)

The purposes of these specifications are to describe the parts of the installation in which dust occurs; to characterize the influences leading to the formation of dust; to point out measures for the selection of suitable dust-removal installations and their maintenance; and to establsih guide stacks are considered as means to minimize the ground level lines for the restriction of dust emission by new installations. Centrifugal separators, electrostatic precipitators, and concentration of particulates.

06563

RESTRICTING DUST EMISSION FROM FORCED-DRAFT BOILER INSTALLATIONS, CAPACITY 30 TON/HR AND OVER, HARD COAL-DUST FIRED WITH DRY ASH REMOVAL. (Staubauswurfbegrenzung Dampferzeuger uber 10 t/h Leistung Steinkohlen-Staubfeuerungen mit trockenem Ascheabzug.) VDI (Verein Deutscher Ingenieure) Kommission Reinhaltung der Luft, Duesseldorf, Germany. (VDI 2092.) (Nov. 1961). 27 pp. Ger. (Tr.)

The occurrence and reduction of dust in steam-generating installations with a capacity of over 30 ton/hr. are reviewed. The purpose is: to describe parts of the installation in which dust occurs; to characterize the influences leading to the formation of dust; to point out measures for the selection of suitable dust-removal installations and their maintenance; and to establish guide lines for the restriction of dust emission by new installations. Centrifugal separators, electrostatic precipitators, and stacks are considered as means to minimize the ground level concentration of particulates.

06781

(PRESERVATION OF AIR PURITY AND THE PRODUCTION OF POWER.) Maintien de la Purete de l'Air et Production d'Energie. Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1967.) 4 pp. Fr. (Rept. No. CI 306.) (C.I.T.E.P.A. Document No. 24.)

After a joint meeting of three German and three American experts on air pollution from large boilers and other sources, the problem of pollution was discussed with representatives of the Ministry of Labor and Social Affairs and the owners of large boilers in the State of North Rhine-Westphalia, in West Germany. The differences in approach, the climatic conditions, the size of the country, and the type of regulatory authority were explored. Various controls were investigated such as the use of high stacks, low-sulfur fuels, sulfur dioxide removal, and electrostatic precipitators. There is a short discussion of smog formation in California by photochemical action. In Germany, federal law governs the regulation of air pollution. Also in Germany, federal law governs the regulation of air pollution. Also in Germany the regulations cover individual parts of the installations, while in the United States the main consideration is the concentration of the pollutant in the ambient air produced by the installation. While investigations into the elimination of pollution continue, reliance on high stacks is suggested.

07430

W. A. Pollock, J. P. Tomany, G. G. Frieling

FLUE-GAS SCRUBBER. Mech. Eng., 89(8):21-25, Aug. 1968.

The Turbulent Contact Absorber (TAC), utilizes turbulent motion of mobile packing to maintain high mass-transfer rates and efficient particulate collection over a wide range of flows with low pressure drop in the presence of a dense low pH slurry. This wet scrubber was tested for sulfur dioxide removal without sulfur recovery. Limestone injection directly into a coal-burning furnace to reduce SO2 emission was evaluated separately. From the data developed on the two systems it appears probable that limestone injection together with wet scrubber would result in effective simultaneous removal fo fly ash and sulfur dioxide. Flyash collection efficiencies in the order of 98% and SO2 removal of 91% can be expected at wet scrubber pressure drops of about 4.5 in. wg.

07527

I. Hagiwara

PREVENTION OF SMOKE AND SOOT BY ADDING ADDITIVES TO HEAVY OIL. Text in Japanese. Netsu Kanri (Tokyo) 19(4):31-35, April 1967.

Two experiments were performed to investigate the effect of additives on the prevention of soot and on the efficiency of the boiler. The specifications of the boiler used were: heat conductivity area, 537 sq. m., maximum pressure used, 10 kg/sq. cm., and maximum steam production 20 tons/hr. One experiment was to determine the effect of a liquid additive to prevent sludge formation. In the other, powder was added to prevent soot formation and the effect of the soot decrease on the low-temperature section of the boiler was also determined. Results showed that the efficiency of the boiler was not affected and that the additive caused a remarkable soot decrease. The life span of the low-temperature part of the boiler was lengthened by use of the additive. Data on efficiency change and soot reduction due to additives are tabulated.

07535

W. Leithe

CLEAN AIR MAINTENANCE - AN IMPORTANT TASK FOR CHEMISTRY AND ECONOMY. (Reinhaltung der Luft - ein dringendes Anliegen fur Chemie und Wirtschaft.) Text in German. Allgem. Prakt. Chem. (Vienna), 18(8):239-241, Sept. 10-17, 1967. 4 refs.

This article is a summary of two lectures given at meetings of chemical societies. The problem of air pollution and some control methods are outlined. Typical examples of well-known air pollution problems are mentioned: London's smog chiefly caused by domestic heating, the smog of Los Angeles due to automobiles, the sun, and temperature inversions, and the industrial air pollution of the Ruhr Valley. Some characteristic data for all three examples are quoted. The techniques for the control of dust emissions are farthest advanced. This is verified by the fact that in Germany, emission of cement dusts decreased to one third while the production of cement tripled in the last 17 years. Far less satisfactory is the control of SO2 emissions. About twice as much sulfur is blown into the air than is used for the production of sulfuric acid. Some wet and dry processes for the elimination of SO2 from smoke are mentioned, but no method is known today which is both effective and economical. The chemical industry tackled its problems mostly by reducing the emission of air polluting substances by increasing the efficiencies of the relevant chemical processes. Examples are the production of sulfuric acid and nitric acid. Organic compounds can be recovered by either absorption on activated charcoal or oxidation by catalytic afterburners.

07537

A. E. Lock

REDUCTION OF ATMOSPHERIC POLLUTION BY EFFICIENT COMBUSTION CONTROL. Plant Eng. (London), 11(5):305-309, May 1967.

Emissions from the combustion of coal and oil by industrial plants are discussed. While individual industrial steam plants are much smaller than the smallest of the modern power plants, they pose a problem because of the concentration in industrial areas and the lack of efficient operation and supervision as compared to the modern electric power plant. It is not uncommon in an industrial plant to have the heating load double that of the process load which leads to difficulties during the summer. During light loads, with low-volume discharge and low velocity in the stack, there may be flow downward inside the stack with the cold air causing condensation in the stack leading to corrosion and eventually to smut emission. A case is described in which various additives were added to the fuel to control the SO2 while an effort was made to increase the stack velocity by installing a chimney cowl and increasing the volume of the powerhouse fan which resulted in a decrease from 2 high of 36.9 parts per hundred million to 7.2 at ground level from the combined effects. New turf which replaced the badly affected grassland showed continued growth and denuded trees showed recovery of foliage. In an instance where a proprietary powdered additive was injected into the combustion chamber, there was no reduction in SO2 but the conversion to SO3 was decreased from 3 to 0.6%. Using a minimum of excess air undoubtedly prevents many of the problems, but careful control is required since the borderline between a minimum excess and insufficient air for complete combustion is narrow and easily crossed under fluctuating load conditions typical of industrial operations.

07557

Electrostatic Precipitation Sub-Committee

SPECIFICATIONS REQUIRED FOR DESIGN OF ELECTROSTATIC OR COMBINATION MECHANICAL-ELECTROSTATIC COLLECTORS FOR FLY ASH COLLECTION FROM BOILER GASES. J. Air Pollution Control Assoc., 8(3):249-254, Nov. 1958.

The specification or request for bids which covers the essential data required by the manufacturers of fly ash collectors to intelligently analyze ezch problem are discussed. Additional data which the purchaser can supply are helpful to bidders. A list of questions, the answers to which the purchaser would like to have to properly analyze the bids, should be attached to the request for bids. The appendices establish standard methods of chemical analysis of fly ash and methods of determining resistivity and particle size.

07752

Kopita, R. and T. G. Gleason

WET SCRUBBING OF BOILER FLUE GAS. Chem. Eng. Progr., 64(1):74-78, Jan. 1968. 5 refs. (Presented at the 62nd National Meeting, American Institute of Chemcial Engineers, Salt Lake City, Utah, May 21-24, 1967.)

A wet scrubbing system that can be designed to remove 99 plus percent of the fly ash from the pulverized coal and stoker fired boilers is described. The same type of system can be utilized to remove 70 to 99.5 percent of the sulphur dioxide in the flue gas depending on the amount and type of absorbing liquid used. The cost of such a system is such that an early pay-out could result as compared to the extra cost of low sulphur fuel. The text and tables illustrate the effeciciencies that may be expected with respect to both SO2 and particulate matter removal, suitable materials of construction and various flow cycles including low-level heat recovery.

07839

Etoc, Pierre

THE USE OF AMMONIA TO ELIMINATE ACID SMUTS FROM OIL-FIRED PLANT. J. Inst. Fuel, 40(317):249-251, June 1967. 11 refs.

The process of injecting ammonia into the flue gases from oil-fired boilers was developed initially to reduce the corrosion of low- temperature heat exchange surfaces by condensed sulphuric acid. It has been shown that sulphuric acid condensation is also a necessary precursor to the formation of acid smuts on these and other cold surfaces, such as chimney and duct walls. This paper describes the successful elimination of these smuts by injecting gaseous ammonia or ammonia solution into the flue ways of industrial and central heating boilers. (Author0s abstract)

07881

Grumer, J., M. E. Harris, V. R. Rowe, and E. B. Cook

EFFECT OF RECYCLING COMBUSTION PRODUCTS ON PRODUCTION OF OXIDES OF NITROGEN, CARBON MONOXIDE AND HYDROCARBONS BY GAS BURNER FLAMES. Preprint, Bureau of Mines, Pittsburgh, Pa., 42p., 1967. refs. (Presented at the Symposium on Air Pollution Control Through Applied Combustion Science, 16th Annual Meeting, American Inst. of Chemical Engineers, New York City, Nov. 26-30, 1967)

Gas appliances designed to lessen the emission of oxides of nitrogen, carbon monoxide, and hydrocarbons, are desired. The formation and decay of oxides of nitrogen and carbon monoxide in the secondary combustion zone of gas-burner flames were investigated as functions of temperature, cooling rate (temperature gradient), and degree of recycling of combustion products into the primary combustion zone of the flame; preliminary measurements were made on hydrocarbons from flames. Recycling, though effective in reducing nitrogen oxides concentrations in effluent from gas appliances, makes the flames longer and less stable. Nitrogen oxides may be reduced by keeping the primary combustion temperature as low as possible, preferably no higher than about 3,000 deg. F., and by starting to cool the combustion gases as soon as possible to about 2,300 deg. F at which temperature concentrations of nitrogen oxides do not increase within the residence time in most gas appliances. Concentrations of carbon monoxide are lowered by recycling of flue gases. The oxidation rate of carbon monoxide is strongly increased by increasing the oxygen concentration. Although the point has yet to be proven by future research, it appears that carbon monoxide concentrations may best be lowered by appliance designs that allow rapid induction of secondary air into the secondary combustion zones. Hydrocarbons can escape from gas burner flames by flowing from the preheat zone of partially lifted flames through the dead space into the surrounding cold atmosphere. Recycling of combustion gases, very low fuel-air ratio, and very high flow rates tend to promote partial lifting of flames from burner ports. It is possible that the emission of hydrocarbons by gas appliances may largely be avoided by designing for well-seated flames on burner ports.

07932

D. W. Ertl

ELECTROSTATIC GAS CLEANING. (DISCUSSION AND AUTHOR'S REPLY.) S. African Mech. Engr. (Johannesburg), 17(1):13-20, Aug. 1967.

The author's paper which was published in the March issue, is discussed. Rapping has to be adjusted to suit the particular dust, and the moisture and temperature conditions in the plant. Since these conditions vary with boiler load, atmospheric conditions, composition and wetness of coal received, gas dew point, etc. it is possible to adjust for optimum rapping only for average condition rather than for particular conditions since the latter vary from hour to hour. Good gas distribution plays an important part in electrofilter performance in the cement industry and older units are likely to be defective in this regard. Also, a cyclone before the precipitator has advantages in permitting continuous operation for long periods at maximum recovery. The design of a commercial electrostatic precipitator requires not only a knowledge of the process to be controlled, but information on metal fatigue, the vibration characteristics of the electrodes under impact blows, corrosion resistance of the construction materials, and the properties of the dust or fume being trapped. The properties of highly resistant dust are discussed with reference to fly ash from low sulfur content coal. Dust resistivity is influenced by the dew point of the gases and the carbon content of the dust, which is the reason that the modern boiler with a lower carbon content in the dust has a problem with resistive dust. The design and operation of a steam generator have a decisive influence on precipitator action.

07971

Kukin, Ira

CHEMICAL SUPPLEMENTS IN AIR POLLUTION CONTROL PROGRAMS. Apollo Chemical Corp., Clifton, N.J., FL-67-65, ((32))p., 1967. 12 refs. (Presented at the National Fuels and Lubricants Meeting, New York, N. Y., Sept. 13-14, 1967.)

Several classes of chemical additives for petroleum fuels and coals have been developed that reduce air pollutants from smoke stacks. These are: (1) combustion catalysts, (2) smoke-suppressants, (3) oil-ash (slag) modifiers, (4) absorptive agents, (5) SO_3 neutralizing agents. The application of these products to specific air pollution reduction programs is shown by several case histories involving the following power plants: (1) 4-cycle diesel trucks, (2) 2-cycle diesel buses, (3) diesel power generating equipment, (4) gas turbine for peaking operations, (5) school heating equipment with No. 4 oil, (6) industrial plant boiler with Bunker C fuel, (7) refinery boiler burning No. 6 oil and gas, (8) marine steam plant, (9) utility power plant, (10) coal-fired utility. These specific examples cover the known types of polluting materials from fuel and coal burning power plants. A ready guide for specific utilization of the chemical treatments is summarized. It has been shown that chemical supplements are 80 to 100% effective for improving the combustion of the fuels resulting in a decrease of smoke, particulate matter, odors and aerosols as well as acidic and acrid SO_3 with a resultant reduction in stack plume. Chemical supplements appear to be uneconomical generally to completely eliminate SO_2 from the exhaust gases. There are indications, however, that by reducing the aerosols forming soots and particulate matter from the exit gases, the smog-forming tendencies of SO_2 are reduced substantially.

08155

Matsak, V. G.

THE UTILIZATION OF AIR DUST AND SMOKE PURIFICATION EQUIPMENT. In: Survey of U. S. S. R. Literature on Air Pollution and Related Occupational Diseases. Translated from Russian by B. S. Levine. National Bureau of Standards, Washington, D. C., Inst. for Applied Tech., Vol. 3, p. 141-149, May 1960 CFSTI: TT 60-21475

In purifying air and gases from dust, the following factos must be taken into account: a)the weight of dust, which may vary from a few milligrams to tens of grams per cu m of air or gas; b) the size of dust particles and their weight/number ratios; c) the chemical composition of the dust and its susceptibility to wetting by water, oil and similar fluids. Existing means of purifying air from dust and smoke can be divided into dry and wet methods. Settling chambers, inertia dust separators, porous filters, electrostatic precipitators, water spray washing, and oil filters are discussed.

08343

Walker, A. B.

NEW DEVELOPMENTS IN THE CONTROL OF PARTICULATE EMISSION. Proc. MECAR Symp., New Developments in Air Pollution Control, Metropolitan Engineers Council on Air Resources, New York City, p. 12-20, Oct. 23, 1967. 33 refs.

Some highlights of recent new developments in particulate collection equipment are presented. Progress has come about as a result of mature technology rather than new concepts. The control equipment discussed are: Electrostatic precipitators, fabric filters, wet scrubbers and mechanical collectors.

08616

Sickles, D.

TWELVE WAYS TO INCREASE THE EFFICIENCY OF YOUR ELECTROSTATIC PRECIPITATOR. Power, 111(11):75-78, Nov. 1967.

Twelve (12) ways to improve the performance of older existing electrostatic precipitators include the following: (1) Add another precipitator in series, (2) add another precipitator in parallel, (3) add mechanical collectors, (4) enlarge existing precipitator, (5) improve flow to precipitator, (6) improve rapping, (7) modernize electrical rectivication, (8) modernize controls, (9) increase electrical sectioning, (10) reduce load on the precipitator, (11) change inlet temperature and, (12) chemical conditioning.

08695

Mathur, M. L., and N.R.L. Maccalum.

SWIRLING AIR JETS ISSUING FROM VANE SWIRLERS. PART I: FREE JETS. J. Inst. Fuel, 49(316):214-224, May 1967. 34 refs.

Designs of vane swirlers for efficient direction of the air are discussed. A design of hubless swirler is suggested for studying swirling jets. The pressure drop across swirlers and hence the efficiency of the swirl generator is derived from theoretical considerations and is confirmed by experimental results. It is shown that a swirling jet experiences a sudden expansion soon after it issues from the nozzle but after about 2 to 4 d the expansion becomes nearly linear with similar spread angles for jets having varying degrees of swirl. For vane angles of 45 degrees and higher the sub-atmospheric pressure in the central zone of the jet near the nozzle is strong enough to induse recirculation.

08741

DUST TECHNIQUE. ((Staubtechnik.)) Text in German. VDI (Ver. Deut. Ingr.) Z. (0DUESSELDORF), 107(5):683-687, 0MAY 1965. 45 refs.

Emission sources, measurement methods, and control methods are re- viewed. Most of the papers reviewed were published in 1964. Subjects include the determination of particle size, the pneumatic atomization of small amounts of glass or quartz powder by three methods, air purity in steam generation plants, the dust removal in tar separator plants, description of a new filter which utilizes polarization in an electric field, and the purification of waste gases by the use of siliconized glass fiber bag filters, which tolerate temperatures to 400 deg. C. Purified gases with 1 mg./ normal cu m. dust content were obtained from waste gases containing 800 mg./normal cu m. dust after purification with the above filter. Several new centrifugal and wet cyclone dust separators as well as wet electrostatic and vibration filters are described. A new method for the determination of the dust content of pure gases is described and schematically illustrated. Several other gravi- metric measurement devices as well as an aerosol spectrometer are described. Several methods for the prevention of dust explosions are outlined, and the legal questions in regard to dust control are briefly discussed.

08825

Zentgraf, Karl-Martin

CONTRIBUTION TO SO2 MEASUREMENT IN FLUE GASES AND TO FLUE GAS DESULFURIZATION BY COMBINATION WITH ALKALINE EARTH METALS. ((Beitrag zur SO2-Messung in Rauchgasen und zur Rauchgasentschwefelung mit Verbindungen der Erdalkalimetalle.)) Text in German. VDI (Ver. Deut. Ingr. Ingr.) Z. (Duesseldorf), 109(35):1689, Dec. 1967.

An infrared absorption apparatus was used for the determination of the amount of SO2 in flue gases. The parts of the apparatus were constructed of Teflon, quartz or polyethylene to prevent the absorption or adsorption of SO2. The transverse strain sensitivity of the apparatus towards CO and CO2 was removed by a modification of the apparatus, and the water content of the gas was reduced by means of a sulfuric acid drip column. The apparatus proved feasible technologically, but since its involved calibrations require the use of specially trained personnel it presents economic difficulties. Experiments for the desulfurization of flue gases were conducted in a coal-fired wet bottom boiler with a steam capacity of 110 t./hr. A desulfurization of 26-31% was obtained with a double stoichiometric addition of dolomite-calcium hydroxide at a flue gas temperature of 1150 deg C. A 19-29% desulfurization effect was obtained with the 1.2 times stoichiometric addition of limestone meal (particle size 95% less than 90 micro m at a flue gas temperature of 1500 deg C. It is not practical to use desulfurization with fly dust recyclization, since the sinter products of the desulfurization compounds cause excessive amounts of dirt. By the use of calcium hydroxide, 70% of the SO2 is bound as the sulfate and 30% as the sulfite and the dust discharge is smaller with the use of a desulfurization compound without fly dust recyclization than during normal vessel operation with fly dust recyclization. The cost of the various desulfurization compounds is briefly discussed.

08957

Kito, Nobuo

AN EXPERIENCE OF SMOKE PREVENTION IN A SMALL FACTORY. Text in Japanese. NetsuKanri (Heat Engineering) (Tokyo), 19(7): 36-39, July 1967.

Following complaints from residents, a textile dyeing factory had to find causes and remedies for air pollution and soot. Pollution was found to be evinced by incomplete combustion, excessive SO2, and by meteorological inversion. Adjustment of the boiler by the manufacturer, experiments with different fuel oils, use of a combustion intensifier and the repair of the flue brought no im- provement. An analysis by some experts (results tabulated) led to an investigation of the relationship between the quantity of the air and the gas pressure at the exit of the boiler. The roblem was solved by controlling the quantity of air with a draft regulator attached to the flue. This regulator adjusts the aperture of the air intake, regulates the quantity of air, and stabilizes the pressure inside the flue. The soot stopped re- gardless of wind velocity and burner load. Boiler manufacturers are cautioned about determining flue gas capacity, especially for ready-made stacks. Although boilers come equipped with automatic ventilatory control devices, when the load varies greatly, the device cannot adequately compensate. The cost of a draft regulator (ca. 30,000) will be repaid by more efficient and economical combustion capacity.

09164

Lee, G. K., E. R. Mitchell, and R. G. Grimsey

FORMATION OF OIL ASH DEPOSITS ON BOILER SURFACES AND CONTROL BY AN ADDITIVE. In: Proc. Am. Power Conference, 28th Ann. Meeting, Chicago, Ill., April 26-28, 1966. Vol. 28, p. 613-626. 5 refs.

The effectiveness of additives on superheater ash deposit structure in naval boilers is evaluated. The physical, chemical and mineral characteristics of the deposits are summarized and they verify that an additive composition containing magnesium and aluminum oxides has the most beneficial effect on deposit structure. A study on the mechanism of ash deposition, in which control of ash deposition is being attempted by improving the combustion process is also described. The dominant mechanism controlling buildup of slag in naval boilers is apparently one of vapor phase diffusion. This being the case, superheater slagging in the present design of naval boilers can be reduced by using an ashless fuel or a residual fuel treated with an additive, so long as it will positively improve the thermal-physical properties of the oil ash. However, the slagging problem may be overcome by development of unconventional boiler and burner design concepts. Another solution may lie in the use of low excess combustion air, but this technique seems to be too risky for marine boilers at the present stage of burner development.

09191

J. L Burdock

FLY ASH COLLECTION FROM OIL-FIRED BOILERS. Preprint, UOP Air Correction Div., Greenwich, Conn., 15p., 1966. 4 refs. (Presented at the 10th Annual Technical Meeting of the New England Section of APCA, Hartford, Conn., April 21, 1966.)

Centrifugal separators are generally preferred for collecting fly ash emissions from oil-fired boilers. Selection of centrifugal collectors depends on three things--size distribution of the particulate matter, the characteristics of the cyclone, and the degree of clean-up required. Purchasers of new or replacement boilers and collection equipment can be sure of getting equipment suitable for the job by exerting more control over equipment specifications. For the best results, collection equipment should be designed on the basis of careful ash analysis, knowledge of additives to be used, and the use of guaranteed rather than anticipated micron efficiency curves.

09504

PRACTICAL APPLICATIONS OF ADDITIVES TO CONTROL AIR POLLUTION - FOR USE WITH PETROLEUM FUELS. National Petroleum Refiners Association, Washington, D. C., FL-66-46(a), ((38))p., 1966. 6 refs. (Presented at the Fuels and Lubricants Meeting, Philadelphia, Pa., Sept. 15-16, 1966.)

A multipurpose additive for distillate fuels was effective in overcoming problems of floc formation caused by caustic carryover in fuel oils. In addition, this anionic stabilizer provided ex- cellent rust protection. A multipurpose gasoline additive that imparted static rust protection to gasoline was also shown to pro- vide tank cleanliness to gasoline storage tanks and handling sys- tems. Carryover of particulate matter into the gasoline also was eliminated. In marketing, service calls that resulted from clogged filters, as well as vacuum cleanings to remove soot accum- ulation, were reduced or eliminated by the addition of a combustion catalyst-dispersant type additive to No. 2 fuel oils. Smoking from diesel buses and trucks was also reduced by the use of a smoke suppressing agent. In manufacturing, fouling of super- heaters from fuels high in vanadium was eliminated by the use of an ash modifier that converted dense, low melting, slags to light, friable, powders during routine furnace operations. Low tempera- ture, 'dew-point', corrosion of air preheaters and stacks, and problems of SO2 and SO 3 pollution were also reduced. (Au- thor's abstract)

09546

Fernandes, John H., W. Burton Daily, and Robert H. Walpole, Jr.

COAL FIRED BOILER EMISSIONS AND THEIR CONTROL BY THE TWIN CY- CLONE. Combustion, 39(8):24-29, Feb. 1968. (Presented at the Industrial Coal Conference, Lafayette, Ind., Oct. 11-12, 1967.)

In evaluating the standard dry dust collection equipment available today, there is an area of performance capability between the con- ventional high efficiency mechanical dust collector and the perfor- mance levels of other types of collection equipment which is not fulfilled. In many instances, this area of performance will suc- cessfully comply with air pollution control regulations to be enacted in the future. It is in this range of 85 to 95 percent collection efficiency on dust similar to coal fly ash that the Twin Cyclone mechanical dust collector can be most successfully applied. The performance capabilities of the Twin Cyclone mechanical dust collector have been verified through extensive laboratory and field testing programs. The achievement of this high level of performance in a mechanical dust collector has neces- sitated a more sophisticated design with many exclusive features. The performance level of a mechanical dust collector in separating particulate matter is primarily dependent on particle size and particle density. For this reason, the results obtained in the field tests on fly ash collection can be applied to other fuels and materials as an effective air pollution control method or for pro- duct recovery. To date, the company has laboratory tested the performance of the Twin Cyclone on such materials as bark char, phosphate dust, begasse ash, sawdust ash, and salt cake. The suc- cess of these laboratory tests has confirmed the ability of the Twin Cyclone to attain exceptionally high performance in numerous exceptionally high performance in numerous fields of particulate fields of particulate collection. (Authors' summary)

09666

Perry, Harry and J. H. Field

COAL AND SULFUR DIOXIDE POLLUTION. American Society of Mechanical Engineers, New York, Paper 67-WA/PID-6 9p., 1967. 19 refs. (Presented at the Winter Annual Meeting and Annual Meeting and Energy Systems Exposition, Pittsburgh, Pa., Nov. 12-17, 1967.)

The scope of the air pollution problem in the U. S. is briefly reviewed. Sulfur oxides comprise less than 15 percent of total emissionsk but are of considerable present interest because most arise from combustion of relatively low-cost coal and residual oil. Emission limitations for sulfur oxides in several areas are cited. Ten general methods are enumerated to reduce urban levels of sul- fur oxides and their applicability is discussed. An up-to-date review is given of methods to remove sulfur from coal prior to combustion, of injection of limestone or dolomite into the boiler for in-process sulfur oxides removal, and of processes to remove sulfur oxides from stack gases. (Authors' summary)

09792

Polglase, William L.

BOILERS USED AS AFTERBURNERS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 187-192, 1967. GPO: 806-614-30

Fireboxes of boilers and fired heaters can be used under proper conditions, as afterburners to incinerate combustible contaminants. To use a boiler as an afterburner demands that the following coditions exist: (1) The air contaminant must be wholly combustible; (2) The volume of contaminant gases must not be excessive; (3) The oxygen content of the contaminant gases when used as combustion air must be similar to that of air; and (4) An adequate flame must be maintained continuously. The manner of venting contaminated gases, adaptable types of equipment, burners, and safety precautions of boilers as afterburners are discussed. The advantages and disadvantages of using a boiler as an afterburner are listed. Factors that must be determined when evaluating a control system wherein a boiler is to be used as an afterburner are also outlined. An example, calculating some factors that must be considered in determining the feasibility of using a boiler to incinerate exhaust gases from meat processing smokehouses, is illustrated. Test results on several boilers used to incinerate effluents from meat smokehouses and rendering cookers are summarized showing the apparent efficiencies of boilers controlling combustion contaminants, organic acids, and aldehydes.

09833

Walsh, Robert T.

BOILERS, HEATERS, AND STEAM GENERATORS. In: Air Pollution Engineering Manual. (Air Pollution Control Dis- trict, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Cen- ter for Air Pollution Control, PHS-Pub-999-AP-40, p. 525- 558, 1967. GPO: 806-614-40

Boilers, heaters, and steam plants which burn fossil fuels (oil or gas) produce large quantities of particulates oxides of sulfur and nitrogen, and acid mist due to hydrolysis of SO3. Particulate emission during normal operation and tube cleaning is discussed. The formation, reactions, kinetics, and equilibria for NOx and SOx are presented which form the basis for recommendation on firebox temperatures, combustion oxygen concentrations, and burner design for optimum performance. Pollution control equipment, such as cyclones, filters, electrical precipitators, alkaline additives, metal oxide and carbon filled adsorbers, afterburners, and various scrubbers are described and evaluated. Experimental data is given for several methods of control. Lowering excess air, catalytic decomposition of NOx, reducing flame temperatures, and eliminating air preheat are also discussed. Consideration is given to the economics of emission control, especially SOx, and to thermal efficiency.

09923

HOW MUCH DUST IS IN FLUE GAS? **Power, 111(5):86-87, May 1967.**

New stack-emission limits increase the importance of dust collectors, but estimating dust content has been difficult. The report of a statistical study is presented which shows a correlation between particulate emissions and the ash content of the coal burned. Data on emissions from steam plants were submitted. The concentration at the steam generator outlet was measured. Size distributions were given also. The major variables were; particulate emission, size distribution and ash content. The survey focused on three types of coal-fired steam generators: pulverized coal; cyclone furnace and stoker fired. The results are presented.

10415

MECHANICAL DUST COLLECTOR SELECTION AND PERFORMANCE EVALUATION GUIDE. J. Air Pollution Control Assoc., 18(7):475-477, July 1968

Guidelines are established which will allow the proper specification of mechanical dust collectors. This aids the supplier in conforming to the user requirements, and helps the user evaluate the equipment once it has been delivered. The criteria for testing, such as particle size distributions, pressures, temperatures, flow rates, and many others, are mentioned.

10993

Opladen, H. B.

COMPUTER-OPTIMIZED FIRE REDUCES AIR POLLUTION. Instrum. Technol., 15(8):63-66, Aug. 1968.

Increasing emphasis on air pollution control dictates that any new oil-fired plants include methods for reducing pollutants to permissible levels. The inherent computational and logical capabilities of digital computers can be applied to optimize combustion in oil-fired steam power plant. The computer can find the necessary percentage of excess air to minimize carbon monozide without sinsible heat loss. It can also determine the best pressure for atomizing fuel oils, achieving an oil droplet size that gives maximum burnout and reduces smoke emission.

11056

Zentgraf, K. M.

FULL-SPACE INDUSTRIAL TESTS OF WASTE GAS DESULFURIZATION. Staub (English translation), 28(3):6-14, March 1968. CFSTI: TT 68-50448/3

The state of development of three methods for flue gas desulfuri- zation (the additive method, also called Wicker method, Reinluft luft method and Still method) is reported. The Wickert method has been tested on a slagtap boiler of a maximum steam output of 110t/h. The results are compared with measurements carried out for oil-fired boilers. An experimental plant according to the Reinluft method, designed for a flue gas rate of 33,000 N cu m, has been in operation since November 1966. Tests in a full-scale industrial plant according to the Still method (20,000 to 30,000 N cu m flue gas/h) were undertaken in November 1967. Operating costs of the three methods are discussed. (Author's summary)

11178

A.K. Jain, P.M. Chen, J.W. Bishop, E.B. Robinson, and S. Ehrlich

STATUS OF THE DIRECT HEAT TRANSFERRING FLUIDIZED BED BOILER. Preprint, American Society of Mechanical Engineers, New York, 12p., 1968. 4 refs. (Presented at the ASME Annual Meeting and Energy System Exposition, New York, N. Y. Dec. 1-5, 1968, Paper 68-WA/FU-J.)

The recent fluidized bed boiler development work sponsored by the Office of Coal Research and the Department of Interior is des- cribed. Basically the system involves replacement of the con- ventional boiler furnace with fluidized suspension of intert ma- terial into which coal is injected and burned. High-heat re- leases and heat transfer direct from bed material to heating sur- face obtained by this process reult in very high steaming capaci- ties from an exceptionally small boiler. From experimental data derived in operation of a full-scale single-module boiler, packaged railroad transportable units can be built up to 300,000 lb/hr capacity or larger. The envisioned utility boilers of 2,000,000 lb/hr and greater represent about 15 percent of the overall size of a similar capacity pulverized coal unit. En- visioned large cost savings should make coal more competitive as a boiler fuel. The use of limestone for sulfur-oxide abatement in this system is far more effective than the open furnaces or gas passes of conventional boilers. SO2 reductions of 65 percent have already been accomplished and greater reductions are antici- pated. (Authors' abstract)

11247

Jack E. Newell

SULPHUR FROM FLUE GASES A PROCESS EVALUATION USING ABSORPTION ON ALKALISED ALUMINA. Preprint, Central Electricity Generating Board, London (England), 17p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Prototype Research and Development of Sulfur Pollution Control Processes, Los Angeles, Calif., Dec. 1-5, 1968, Paper 54d.)

The alkalised alumina process, has been developed in Britain using fluidised bed reactors rather than the dispersed phase system favoured by the original American authors. The functional emphasis for the process in Britain also differs in that commercial recovery of sulphur is the primary objective, air pollution control being secondary. Thus, the design aims at low capital investment and economic commercial operation, rather than at high gas cleanup efficiency, the plant recovering sulphur at an almost constant rate regardless of actual sulphur input and operating 24 hours per day even when the associated boiler plant shuts down overnight. This has necessitated a new regeneration system and a different approach to thermal economy from that described in the author's earlier paper which aimed at high cleanup efficiency and full thermal integration with the power station heat cycle. In addition to discussing the design of process plant, the paper presents costing and economic evaluation. It also shows the suitability of the plant for use at large industrial sites other than power stations. (Author's abstract)

11251

Smith, M. C. and A. A. Salerno

ENGINEERING FOR LOW SULFUR FUELS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1968. (Presented at the ASME Annual and Energy Systems Exposition, New York, N.Y. Dec. 1-5, 1968, Paper 68-WA/APC-1.)

Engineering for low-sulfur fuels must recognize several things. Electrostatic precipitators on low-sulfur coal have lowered efficiencies. The difficulty of obtaining low fusion point coal with low-sulfur content for use in wet bottom boilers may force conversion away from this type of boiler. Low-sulfur oil may very well have a high pour point which makes heating of fuel lines necessary. Viscosity limits are necessary to be assured that existing system fuel oil pumps can continue to be used.

11256

SO_2 REMOVED FROM FLUE GASES. Oil and Gas J., 66(46):102, Nov. 11, 1968.

A system now available promises a solution to sulfur dioxide emission problems in flue gases of boilers. Called the Cat-Ox system, it is a catalytic oxidation process. The process involves taking hot flue gases from a boiler and passing them first through a hot electrostatic precipitator then through a converter where sulfur dioxide is catalytically oxidized to sulfur trioxide. From the converter the gases pass through a high-level economizer and an air preheater to recover heat which is sent back to the boiler cycle.

11491

Kalyuzhnyi, D. N.,N.Y. Yanysheva,M. V. Kryzhanovskaya,
Z. Y. Rudchuk, A. Z. Zaks, and M. S. Burakovich

AIR POLLUTION CONTROL IN URBAN AND RURAL AREAS IN THE UKRAINE. ((Opyt ozdorovleniya atmosfernogo vozdukha v gorodakh i selakh Ukrainskoi SSR.)) Hyg. Sanit. (English translation of: Gigiena i Sanit.), 33(4-6):261-263, April-June 1968. CFSTI: TT 68-50449/2

Research and practical work in air pollution control in the Ukraine, over a period of many years, has at all stages been conducted in close collaboration with practical sanitation services and many planning and economic organizations. The value of planning measures, the construction of purifying installations, and the introduction of gas as a fuel for dwellings and large industrial, communal and household boiler rooms, have been generally recognized and widely implemented. The government of the Ukrainian republic annually allocates large sums for the construction of purifying installations for enterprises under construction, being reconstructed or in operation. Information concerning the purifying installations and gas-fueled boiler rooms constructed in the major industrial regions in the Ukraine over the last three years is given. Another important achievement in the control of industrial atmospheric pollution has been the organization in many enterprises of special offices for the operation and monitoring of purifying installations.

11726

Green, Bobby L.

BOILER FOR BARK-BURNING. Power Eng., 72(9):52-53, Sept. 1968

Burning bark involves special problems: incomplete combustion (and resultant gum-plugging in the system), dust and residue buildup, and multi-fuel firing caused by fluctuations in the supplies of bark. A paper mill has been burning bark in one of its boilers for 6 years. The boiler has a rated evaporation capacity of 300,000 lb/hr. and is provided with rotary regenerative air preheaters. The paper mill requires a continuous firing schedule of 75% to full capacity. When the bark supply is insufficient, natural gas is used. Equipment specifications include: horizontal-flow package regenerative air preheater (Ljungstrom), traveling grate stoker, large tube fly-ash collector, and hydraulic ash-disposal system. The boiler was designed to burn 35% and 65% natural gas, but operating logs show that the percentage of bark has been as high as 85%. A schematic drawing shows the arrangement of the preheating system. A cyclone dust collector, with large size tubes, is located in the flue gas path ahead of the air preheater. The cyclone removes bark char, fly ash, and other light material. The operating temperature is about 700 deg F. Features of the dust collection system are dust valves, a sand classifier, a cinder reinjection system, and a wet ash sluice system. Although no significant problems have been encountered in the 6 years of operation, initially some minor buildup did occur in the boiler superheater section when an unusually difficult combination of hardwood bark was burned. The problem was solved by the installation of retractable soot glowers. It has not been necessary to wash the preheater.

12090

NEW OIL ADDITIVES CONTROL AIR POLLUTION. Chem. In Can., 20(11):9, Nov. 1968.

Two new products, one a paint, the other an oil additive, are proving to be effective in control of air pollution. The first is a water base paint to prevent low temperature corrosion in commercial hot water or low pressure fire tube boilers. It must be applied every 1 to 4 weeks and protects completely against H_2SO_4 corrosion. The second formulation is a multipurpose oil additive for industrial and power utility boilers where fire side surfaces are not readily accessible. The results show it to be particularly effective in alleviating high temperature slagging and corrosion, preventing corrosion and fouling of cold end boiler surfaces, and reducing emissions of NO_x, SO_3, and acid soot to the atmosphere.

12308

Borgwardt, Robert H., Thomas A. Kittleman, and Larry G. Turner

THE DRY-LIMESTONE PROCESS FOR SULFUR DIOXIDE CONTROL: A FIELD STUDY OF THE ROLE OF OVERBURNING. Air Pollution Control Association, New York City, 19p., 1969. 10 refs. (Presented at the Air Pollution Control Association Annual Meeting, 62nd, New York June 22-26, 1969.)

Two series of injection tests for desulfurization of flue gas were made on a boiler. The boiler fired No. 6 fuel oil containing 2.3% sulfur at a rate of 10,000 pounds oil/hour at an operating load of 150,000 lbs steam/hour. Four different additives (2 limestone and 2 dolomites) were used. During the first series of tests, the effect of boiler load on the degree of burning of additives injected with the fuel was investigated. During the second series, the influence of particle size, iron content, residence time, and injection temperature on the effectiveness of the additives was studied. The dry-limestone process should not be applied by injection with the fuel; additives must instead be injected separately to achieve efficient utilization of the limestone. Overburning is at least partly responsible for the low efficiencies found when additives are fed to the burners. The lime produced by injection with the fuel is much less reactive with SO_2 than lime that is not calcined in the combustion zone. Boiler load was an important variable affecting desulfurization when additives were fed with the fuel. This was due to the higher excess air used during low load. The tests indicated that there is an optimum particle size as well as an optimum injection temperature. Injection temperatures somewhat higher than 2400 F would be best for 2-micron particles.

12446

van Doornum, G. A. W.

PROGRESS IN THE DEVELOPMENT OF SMOKELESS APPLIANCES FOR SOLID FUEL. Council for Scientific and Industrial Research, Pretoria (South Africa), Conference on Air Pollution Capetown, South Africa, 1967, 13p. (Paper no. 6.)

Appliances are described that permit the virtually smokeless combustion of bituminous coal in domestic heaters and industrial boilers. The design of the domestic appliance is characterized by a separate bunker for the storage of fuel, a provision that makes it possible to replenish the fuel supply of a stove without interfering with the combustion process. Preheated secondary air, well distributed, is admitted in an insulated combustion chamber. The hot combustion products can be used for space or water heating or to heat an oven or hotplate. The same principle can be applied on a larger scale, and hot water generators suitable for apartment buildings are now being manufactured. On an industrial scale verticle boiler with secondary air supply, smoke generation is almost completely reduced by injecting air through a small forge blower. Another boiler modification described facilitates ash removal from a boiler.

12478

Tamura, Zensuke

ADSORBENT PROCESS OF SULFUR DIOXIDE REMOVAL FROM FLUE GAS, USING ACTIVE CARBON. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):39-40, 1967. Translated from Japanese. 7p.

The adsorption of sulfur dioxide from flue gas discharged from a boiler by using activated carbon was described. A test plant with a capacity of 2000 kw was built. The adsorbent process takes place as follows: adsorption of S02, 02, and H20 from the flue gas conversion of the adsorbed S02 to S03 by catalysis; and formation of H2S04 by hydration of the S03, so that the original S02 is adsorbed on the activated carbon in the form of H2S04. The H2S04 is easily extracted by washing with water. The activated carbon is thus regenerated and can be used repeatedly. The waste water containing the most concentrated sulfuric acid can be recover as dilute sulfuric acid. Advantages of the process include a high percentage of sulfur removal, simple desorption and regeneration of the activated carbon, and a flue gas temperature of over 100 C. Drying of the activated carbon can be accomplished by the flue gas discharged from the boiler. The process can also be carried out without special conditions and is safe. Since the activated carbon is treated with dry distillation and high temperature steam, its firing point is higher than 400 C. Therefore, there is no danger of its firing during the desorption process with water-washing. In addition, the small amount of dust usually attached to fresh activated carbon can be removed from the apparatus by washing with water in the initial stage of the operation, so that explosions from carbon dust are avoided. Since the flue gas discharged from the air preheater on the boiler is treated directly and then emitted from the stack, no changes in the structure of the boiler are required.

12574

Baxter, W. A.

RECENT ELECTROSTATIC PRECIPITATOR EXPERIENCE WITH AMMONIA CONDITIONING OF POWER BOILER FLUE GASES. J. Air Pollution Assoc., 18(12):817-820, Dec. 1968. 9 ref.

Motivated by heightened recent interest, Koppers Co. has been experimenting with ammonia conditioning of power boiler flue gases for the purpose of improving the precipitability of the emitted fly ash. Chemical reactions resulting from NH3 injection are postulated. Measurements on three pulverized coal and two cyclone fired boilers, all os which emit acidic ash, are described. In all five cases, considerable but varying, increase in precipitator power input and collection efficiency resulted when gaseous NH3 in the amount of 15 ppm was injected between the economizer and air preheater. The conditioned fly ash showed decreased acidity and inconsistent change in electrical resistivity. Unless air heater temperatures were unusually high (greater than 400 deg F), tendency of the air heater to plug was an additional, but unwanted, result. At one station with high air heater outlet temperature NH3 injection has been adopted as a permanent solution to community pressure for reduction of stack discharge. NH3 injection downstream of the air heater produced no effect. Future plans are presented to continue the program beyond present results described in this interim report. Author's Abstract

12672

W. M. Crane, T. J. K. Rolfe

STEAM INJECTION AS A MEANS OF PREVENTING DEPOSIT FORMATION IN ECONOMIC BOILERS. J. Inst. Fuel, 41(334):426-432, Nov. 1968.

Some coals promote heavy formation of bonded deposits in shell boilers and this can lead to stoppage of the plant for cleaning. The work described here was aimed at reducing this deposit formation. The effect of a steam jet in the furnace tube on the formation of bonded deposits was assessed using an Economic boiler while this boiler was being used to supply the central heating load. A cola with a high chlorine content was burnt. In one test, used as a control, the boiler was operated in the normal way to provide the daily demand without cleaning the tube bank until the combustion chamber had become severely obstructed by bonded deposits. The boiler was then cleaned and the run was started again, but this time steam was supplied to a jet behind the bridge wall. This run was still in progress at the end of the heating season when, although slightly more coal than in the control run had been burnt, the tube bank was comparatively free of deposits. (Author's Abstract)

13501

AIR-POLLUTION CONTROL: THE SULFUR PROBLEM. Coal Age, 70(8):58- 62, Aug. 1965.

Current research on sulfur dioxide elimination from coal and flue gases is reviewed. Only a fraction of the coal reserves meets the standards set by the Public Health Service for new federal installations (0.7% sulfur for coal and 1.0% for fuel oil), and there is no practical means now available for removing enough sulfur from coal to make it conform to this standard. The alternat approach to control of sulfur dioxide emission is through the application of a process for recovering sulfur dioxide from the flu gases after burning but prior to emission from the stack. A gas-processing device could enable the reduction of SO2 emission to 300 ppm with a 3.4% sulfur coal, about 10% of the normal amount for such a coal. Three processes which appear promising are the Reinluft process, the alkalized-alumina process, and the catalytic gas-phase process. Costs for 1965 are given.

13857

Frazier, J. H.

COAL FIRED BOILER STACK EMISSION CONTROL. Nat. Eng., 73(8):8-10, Aug. 1969.

A large corporation, through various divisions, operates a large number of coal-fired boilers. When emissions are marginal, or excessive, the boiler units are revised or replaced to comply with new regulations regarding stack emissions. Spreader stoker units are equipped with dust collectors varying in type, arrangement, and the amount of cinders returned to the furnace for reburning. Most of these units are also equipped with either economizers or air heaters for heat recovery. Pulverizer units have mechanical dust collectors, except for four plants where electrostatic units have been installed. The varying equipment, locale, coal, and new or foreseeable applicable emission regulations combine to required a study of emissions from each boiler. However, it is stressed that testing should only be done to satisfy the operator or the air pollution control group, since promiscuous stack testing serves no purpose.

13950

Thurlow, G. G.

FLUID BED COMBUSTION. Preprint, Combustion Engineering Assoc., Hayes, Great Britain, 16p. Nov. 11, 1968. (Presented at the Combustion Engineering Assoc. Meeting, Birmingham, Great Britain, Oct. 15, 1968, Document 8533.)

The technology of fluidized bed combustion and current research and design efforts in its development are described; the application of this system to steam and hot-water boilers is considered potentially the most important advance in the burning of coal since pulverized fuel firing. The principle of the system is to feed coal into a fluidized bed of coal and ash particles; the coal is rapidly dispersed throughout the bed, reacts with the incoming air, and so is burned. The rapid motion of the particles gives a high rate of turbulent mixing and produces a reaction between the coal particles and the air passing through the bed; also, these same rapidly moving particles lead to a high rate of heat transfer between the bed and surfaces in contact with it. By extracting heat from the bed as combustion proceeds, it becomes possible to keep the bed temperature below that at which the particles sinter while maintaining a high rate of chemical reaction and therefore heat release rate. Consequently, unlike earlier proposals of combustion units using fluidization, the ash particles do not get sticky and coalesce, but remain as discrete particles, allowing the heat transfer surfaces to stay clean and effective. By carrying out at least 50% of the heat transfer to the water or steam tubes with the bed, it is expected that smaller, cheaper boilers can be utilized. In addition, the fact that no surfaces are exposed to high gas temperatures should lead to savings in maintenance, while the low bed temperatures should reduce problems of corrosion, deposition, and atmospheric pollution. Other advantages, such as in the types and size of coal that can be burned, are also foreseen. Details of the process are given, and its application to power station water tube type boilers and industrial shell-type boilers is described. It is emphasized that the system is still in the developmental stage, with many problems still to be worked out. A record of extensive discussions by participants at this and two subsequent meetings is included.

14194

Ito, F.

AN EXAMPLE OF SMOKE PREVENTION FOR COAL FIRING APPARATUS OF STEAM JET TYPE. (Joki funshashiki sekitan nensho sochi ni yoru baien boshi no jitsurei). Text in Japanese. Netsu Kanri (Heat Engineering) (Tokyo), 20(2):32-36, Feb. 1968.

A steam jet coal-firing apparatus reduced dust from 2.26 to 0.27 g/cu nm, eliminated black smoke, increased heat efficiency to 50%, and lowered exhaust gas temperatures from 329 to 307 C. Coal content of dust dropped from 12.2 to 8.5%. The size of the apparatus and the number of jets depend on the individual boiler. The inner diameter of the apparatus ranges from approximately 3 to 6 mm and nozzle height from 450 to 650 mm. Steam pressure requirements vary from 0.7 to 1.5 kg/sq cm. Preferably, boiler pressure should be above 4 kg/sq cm. Cost of the apparatus is calculated at 300,000 yen (1968) for pressure less than 4 kg/sq cm and a heat transfer area greater than 15 sq m; at 250,000 yen for pressure less than 4 kg/sq cm and a heat transfer area less than 15 sq m; at 120,000 yen for pressure above 4 kg/sq cm and with a heater; and at 30,000 yen for pressure above 4 kg/sq cm but without a heater.

14221

Kopita, R. and T. G. Gleason

WET SCRUBBING OF BOILER FLUE GAS. Chem. Eng. Progr., 64(1):74- 78, Jan. 1968. 5 refs.

Many new air pollution codes restrict the sulfur content of fuels to 1% and that of fly ash to 0.25 lb/1000 lbs of gas. Wet scrubbers capable of 99% efficiency in particulate removal and 70 to 99% efficiency in SO2 removal are being constructed from corrosion-resistant stainless steel alloys. Several are designed so that a single unit of equipment can be utilized for particulate removal, absorption, and cooling. Equipment and operating costs depend largely on the complexity of the system, but costs are low compared to those for low sulfur-containing fuel. Representative systems include the following cycles: (1) single- pass liquid cycle, (2) liquid recycle, (3) liquid recycle combined with one-fluid absorption, and (4) two recycle systems combined with two-fluid absorption. The first cycle is designed for the removal of particulate matter, and absorption of SO2 or nitrogen oxides is incidental. The system is ideally suited to water. To hold makeup water to a minimum, cycle 2 uses a clarifier to reduce the concentration of solids in recycled liquor. Cycle 3 uses chemical absorption with soda ash, salt water, lime slurry, or sodium carbonate. In its simplest version, the scrubbing medium is a weak soda ash solution. The chemical consumption for a 200,000-hr boiler would be approximately 1000 lbs/hr of soda ash. Using both calcium carbonate slurry and soda ash, cycle 3 reduces soda ash consumption to 500 lbs/hr for a 200,000-hr boiler. The $125,000 installation cost of cycle 3 is typical of costs for these systems.

14262

Napier, D. H. and M. H. Stone

CATALYTIC OXIDATION OF SULPHUR DIOXIDE AT LOW CONCENTRATIONS. J. Appl. Chem., vol. 8:781-786, Dec. 1958. 8 refs.

A suggested process for removing sulfur dioxide from boiler flue gases requires as a first stage the oxidation of sulfur dioxide to sulfur trioxide, followed by the removal of sulfur trioxide as ammonium sulfate or sulfuric acid. The first stage of the process was investigated by passing a synthetic flue gas mixture, with a sulfur dioxide content between 0.13 and 0.17%, through a fixed bed of vanadium catalyst containing by weight

6.7% V2O5 and 7.5% K2O. Results confirm that water vapor and carbon monoxide in the gases have no adverse affect on the catalyst and that the required contact time at low sulfur dioxide concentrations is much lower than that used in the contact process. Equilibrium was obtained for contact times of 0.09 to 0.43 sec. Fractional conversions obtained were close to the equilibrium value of sulfur dioxide concentrations and not dependent on oxygen concentrations. However, the values of the fractional conversion are reproducible to only plus or minus 4%, and the sulfur dioxide concentrations to plus or minus 10%.

14690

Wahnschaffe, E.

CONTINUOUS MEASUREMENTS OF THE SO3-CONTENT AND THE DEW-POINT RANGE IN OIL-FIRED STEAM GENERATORS. (Kontinuierliche SO3- und Taubereichsmessungen an oelgefeurten Dampferzeugern). Text in German. Mitt. Ver. Grosskesselbesitzer, 48(3):193-199, June 1968. 3 refs.

In an oil-fired boiler furnace with a capacity of 175 tons/hr at 125 atm and 490 C, SO3 measurements were taken with the Sulfotherm unit. The measurement was greatly dependent on temperature; only between 580 and 600 C was it feasible to measure the entire SO3 content. Between 1400 and 600 C, SO2 is converted to SO3, but the reaction is never a complete one and some SO2 always remains. Determination of the degree of conversion is impossible, since at 580 C, the conversion of SO3 to H2SO4 begins. Study of dew point and dew point range measurements showed that these methods are also temperature- dependent. At 200 C, H2SO4 begins to precipitate as a film on the probe. The rate of film formation is temperature-independent between 120 and 135 C. Therefore, the measuring probe can be calibrated against the true SO3 concentration. Exact SO3 measurements are important for determining the amount of additives such as CaO, and MgO required to eliminate corrosive substances in the flue gas.

14716

Simonin, J. C.

FIGHTING AIR POLLUTION BY BOILER FUMES. (Lutte contre la pollution atmospherique par les fumees des chaudrieres). Text in French. Chaleur Ind., no. 434:251-266, Sept. 1961. 9 refs.

A general review of air pollution control methods for combustion gases and particulates is presented. Sulfur dioxide emissions from well-regulated boilers presents the greatest control problem. Fuel desulfurization is practical only for natural gas, and not for heavy oils or coal. Removal of SO2 after combustion involves washing, which cools the gas and may seriously impair dispersion of the remaining fumes. Lime, chalk, or ammonia added to the scrubbing water yields recoverable by-products. Over half the atmospheric SO2 is emitted by boilers too small to practice economic extraction of sulfur products. Properly-run gas and oil burners emit little dust. Oil does produce carbon particles of 0.01 micron diameter, which are difficult to remove. Centrifugal cyclone extraction is efficient for particles larger than 30 microns. Electrostatic precipitation can be 99% efficient and cheaply performed. Water separators which trap the dust in fog nuclei are useful for fine particles, although they cool the gas. Artificial fiber filters are recommended for this application. Correct chimney height and gas exit velocity are important for adequate dispersion. Addition of an exit nozzle to an existing chimney can increase the gas velocity without increasing pressure simultaneously.

14838

Borio, Richard W., Robert P. Hensel, Richard C. Ulmer, Hilary A. Grabowski, Edwin B. Wilson, and Joseph W. Leonard

THE CONTROL OF HIGH-TEMPERATURE FIRE-SIDE CORROSION IN UTILITY COAL-FIRED BOILERS. Combustion Engineering, Inc., Windsor, Conn., Research and Product Development, Contract 14-01-0001-485, OCR R&D Rept. 41, 224p., April 25, 1969. 35 refs.

Methods by which coal can be processed to reduce corrosion or damage to fireside surfaces of high-temperature boilers were investigated. Methods for reducing the amount of pollutants were determined. Certain relationships between coal composition and corrosion rates were indicated. Based on the data, the chief constituents affecting corrosion rate are alkalies, alkaline earth metals, iron, and sulfur. The combination of effects of sodium, potassium, alkaline earth metals, and iron made it possible to explain corrosion rates on most of the coals tested. A nomograph was constructed whereby the potential corrosiveness of a given coal can be determined. Also, amounts of neutrality limes and limestones to be added can be established from the nomograph. It also provides a tool by which preparation processes can be modified to reduce the corrosiveness of coal. These results provided the groundwork for a corrosion-reduction study of the entire system of operations, from the seam face where mining begins to the point of loading for shipment. Principle methods of corrosion reduction included analysis of the mining system, coal preparation, and coal additives and blending. To control both sulfur gas emissions and boiler corrosion, it is desirable to maintain an optimum balance between the sulfur level of the coal and the alkaline earth metals retained in the coal or added to the coal. Conventional cleaning using gravity techniques can remove most of the pyritic sulfur and thereby reduce the total sulfur by 50% or more. Such a reduction greatly reduces the sulfur but increases alkaline earth percentages as well. (Author abstract modified)

14844

Tamura, Zensuke, Yukio Hishinuma, and Teruo Hisamura

DESULFURIZATION PROCESS OF FLUE GAS BY ACTIVE CARBONS. Hitachi Rev. (English translation from Japanese of: Hitachi Hyoron), 17(9):343-349, 1968. 3 refs. (Also: Karyoku Hatsuden (Thermal Power Generation), 18(4):361-365, 1967.)

The active carbon adsorption process for desulfurization of boiler flue gas and test results were described for the 6000 N cu m/hr experimental plant built as a first stage of large- scale research and development projects. The flue gas from the air heater of the boiler is stripped of soot and dust, then blown into a tower packed with active carbon. The purified gas is discharged through the chimney. The bypass flue duct is used when the boiler is being started or stopped, when operation of the desulfurization unit is suspended, or during emergency shutdown. Active carbon is contained in a number of towers which are classified by function. In the drying tower section, wet active carbon from the washing and desorption section is dried with the heat of the boiler flue gas, while adsorption of SO2 is achieved. In the adsorption section, SO2 in the flue gas is completely removed. At the same time, water particles and mist contained in the gas from the drying section are removed. The washing and desorption section is designed to wash the active carbon that has adsorbed SO2, extract sulfuric acid and regenerate the carbon for further use. Advantages of the process include a high desulfurization rate, easy desorption and regeneration, flue gas temperature over 100 C, carbon sufficiently dried by the boiler flue gas, a process not affected by geographical or natural conditions, safe operation, and no need to change boiler structure. Operational results from the test plant were given. They showed that the plant was operated smoothly and the practical value and effectiveness of the process were confirmed by various tests. However, in order to industrialize the process, plant size should be expanded. By doing so, structural problems that may arise from the operation of a larger plant, as well as operation in combination with a boiler, should be studied.

14928

Yamamoto, Toshihiko

DUST COLLECTING AND DESULFURIZING APPARATUS FOR COMBUSTION GAS WITH REVOLVING OBLIQUE BARREL. (Shatokaitenshiki nenshoseiseigasu no jojin datsuryu sochi). Text in Japanese. Kami-pa Gikyoshi (J. Japan. Tech. Assoc. Pulp Paper Ind.), 23(10):423-429, Oct. 1969.

A new device, for which a patent has been applied, simultaneously removes dust and sulfur dioxide in a barrel cooled to 20 to 60 C. Decrease in gas diffusion at low temperatures and gas pressure loss in the barrel are compensated for by the use of a blower. The barrel is filled with pieces of wood, which supply a large wet surface area. Sulfur dioxide is absorbed in circulating water with a minute amount of additive to enhance absorption. The water is either oxidized or neutralized after absorbing SO2. Upon turning the barrel, a large area of cooled surface for absorption is provided by the filler. Rotation of the barrel is also effective. Sulfur dioxide in removing dust from the filler surface and in preventing dust accumulation. The exhaust gas is mixed with fresh air by a blower to a harmless concentration and is released to the atmosphere. The filler material can be removed through openings provided in the barrel. The device has a simple construction and can be easily operated; installation cost is extremely low. The device cannot be used without modification when the combustion gas has a large amount of fly ash. The device is effective in cleaning flue gas from boilers, exhaust gas from public baths or incinerators, and in removal of SO2 from chemical processing plant wastes.

14996

Johnstone, H. F.

METALLIC IONS AS CATALYSTS FOR THE REMOVAL OF SULFUR DIOXIDE FROM BOILER FURNACE GASES. Ind. Eng. Chem., 23(5):559-561, May 1931. 7 refs.

The preliminary results are given of attempts to increase the solubility of sulfur dioxide in water to such an extent that the amount of water required for the removal of SO2 would be reduced to a point that would make the process economically and mechanically feasible. The production of sulfuric acid from the sulfur compounds in the gases being scrubbed was also studied. Air containing 0.325% SO2 was passed at a constant rate through 3 liters of water containing the catalyst. The sulfates of iron, manganese, and nickel and various combinations of these and with copper, zinc, and chromium were used as catalysts. Nickel ions showed no catalytic effect in concentrations up to 1.5 grams/l. Manganese ions, in concentrations as low as 0.0028%, exerted a strong catalytic action which increased the capacity of the water to absorb SO2 by approximately 600%. The catalytic effect of ferric ions was somewhat less than that of manganese. Definite promoter action was shown when a very small concentration of manganese was added to dilute ferric solutions. It was found that the presence of a trace of copper ions completely inhibits the action of manganese in any concentration. Removal of the copper by precipitation as copper sulfide was not sufficient to prevent the inhibition. Copper ions, however, had no effect on catalysis by ferric ions. The presence of the copper ions in zinc, nickel, chromium, and the alkali metals neither inhibited nor promoted catalysis by manganese. The effect of the presence of manganese ions on the capacity of the washing water for absorbing sulfur dioxide showed that although the efficiency of the washer operating on flue gases was a great deal lower than that of the laboratory scrubber, it compared favorably with the efficiency obtained by other large scale methods.

15378

PROCEDURE FOR PURIFICATION OF COMBUSTION GASES. (Procede pour l'epuration des gaz de combustion). Text in French. (Societe des Forges et Chantiers de la Mediterranee, France) French Pat. 1,399,747. 3p., May 21, 1965. (Appl. April 10, 1964, 2 claims).

The invention concerns a procedure for purification of combustion gases, particularly of coal- or fuel oil-fired boilers, by means of a heat exchanger made of granulated material and placed in the combustion gas duct. The granulated material may itself contain substances which react with SO2 and SO3 contained in the combustion gas. Such as red bauxite slurry after hardening, or it may be in the form of an inert porous substance which adsorbs SO2 and SO3, such as kieselguhr. The surface of the grains of this material removes the film of acid formed by the reaction of SO2 and SO3 with water when the combustion gas temperature has been lowered sufficiently.

15432

Glaubitz, F.

THE ECONOMIC COMBUSTION OF SULFUR-CONTAINING HEATING OIL. A MEANS OF AVOIDING DEW POINT DIFFICULTIES IN BOILER OPERATION. Combustion, vol. 34:31-35, Jan. 1963. (Presented at a meeting of the work group 'Oil Furnaces' of the VGB, Graz Austria, May 2, 1960.) (Also: Mitt. Ver. Grosskesselbesitzer, no. 68, Oct. 1960.)

Because of furnace and air heater difficulties due to temperatures lower than the dew point at a refinery in Lingen, Germany, the oil burner was redesigned so that sulfur dioxide rather than sulfur trioxide was formed from the combustion process for the purpose of preventing corrosion (since the dew point of flue gases is raised only by sulfur trioxide; on the other hand, sulfur dioxide causes no increase). In the redesigned oil burner air is added in the middle and distributed in such a way that the oil burner is not blown out. A greater part of the air is passed into the atomized oil with a fair velocity through the ring space. The air stream does not rotate around the burner but is passed in parallel to the burner axis. As a result, good combustion is obtained. However, the feed to the oil burners in the furnace walls was nonuniform, due to inadequate burner nozzles and differently abraded pipes. After adjustments, regulation to at least 1:8 was obtained. When the air was throttled up to 0.5% oxygen, the dew point was approximately 110 C with the greatest deposit velocity at 70 C. When pressure-fired oil furnaces were installed with the newly designed burners, dew points of 48 to 52 C could be determined for an air excess of 0.2% oxygen for a flue gas temperature of 250 to 300 C.

15544

Hangebrauck, Robert P. and George D. Kittredge

THE ROLE OF COMBUSTION RESEARCH IN AIR POLLUTION CONTROL. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 17p., Sept. 1969. 10 refs. (Presented at the Combustion Institute, Eastern States Section, Technical Meeting, Morgantown, W. Va., 1969.)

Research and development projects aimed at developing technology for minimizing emissions from combustion processes are reviewed. The projects are discussed in relation to specific pollutants and sources, which include electric power production, industrial and residential combustion, refuse combustion, and motor vehicle sources. For stationary sources of pollution, fluid bed combustion may provide an economical system of heat generation for reducing emissions of sulfur oxides, and perhaps nitrogen oxides, from fossil-fuel combustion by steam-electric power stations. Research is in progress on models for predicting nitrogen fixation; these models would be used in design of burners and boilers for low output of NOx. Another possibility for controlling power generating systems involves integrating new power cycles with fuel cleaning. Improved burner and furnace designs offer opportunities for reducing pollution from sources other than power generators. Current development work in incineration could lead to both lower pollution levels and better use of resources by heat recovery. For motor vehicle sources of pollution, the possibilities of control are diverse. Industry is concentrating chiefly on enhancing combustion in spark-ignition engines by improving fuel atomization, air-fuel mixing, and distribution. Also under study are changes in fuel composition, high-temperature exhaust system reactors, and exhaust gas recirculation for NOx control. Elsewhere, alternative types of low-emission propulsion system, in particular Rankine cycle systems, are under development. Control techniques for diesel engines are directed toward improving fuels and engine designs to eliminate smoke and odor. Finally, projects for reducing emissions from aircraft are underway.

15560

Council for Scientific and Industrial Research, Pretoria (South Africa), Air Pollution Research Group

HOW TO OBTAIN HIGH STEAMING RATES FROM VERTICAL BOILERS FIRED WITH ANTHRACITE. CSIR Res. Rept. 249, 4p., 1966.

Simple modifications were made in a vertical boiler installation in an effort to determine whether a high steaming rate was possible using anthracite instead of bituminous coal with the object of reducing smoke production. A complete energy balance for the boiler was obtained. Using bituminous coal in the experimental boiler, the steaming rate achieved by an experienced stoker was 14% more than that achieved by an inexperienced man. When anthracite coal was used and the stoker was the same inexperienced man, the stack gas flow dropped by 51%, and the steaming rate dropped by 25%. When a forced draught was used with anthracite to bring the stack-gas flow to about the same as it was when bituminous coal was used, the steaming rate was 56% higher than when anthracite was used without a forced draught and 17% higher than when bituminous coal was used. The highest efficiency was obtained when anthracite was used with a natural draught. The flow rate of gases through the boiler is such that some combustion takes place in the stack, thus causing a heat loss. Worthwhile savings could be achieved if a simple economizer were installed above the boiler. This boiler can be applied in industry if the draught is increased so as to make the stack-gas flow rate approximately the same as when bituminous coal is used.

15611

Motonaga, Hidekazu

SOME ASPECT ON DUST COLLECTION BY COMBINATION SYSTEM OF ELECTROSTATIC PRECIPITATOR AND MULTICYCLONE. (Denki shujinki oyobi maruti-saikuron no kumiawase hoshiki niyoru shujin ni tsuite no ichikosatsu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(5):363-368, 1969. 8 refs.

The efficiencies of an electrostatic precipitator (EP) alone and various combination of the EP and the multicyclone (MC), which collects the dust from a boiler which burns powdered carbon or from a hearth which burns solid wastes, are discussed. For dust from the boiler, collection efficiencies were 89.2 to 98% using EP alone; 89.2 to 98.3% using the MC-EP combination, and 96.8 to 99% using EP-MC or MC-EP-MC (MC' is a multicyclone with higher efficiency). The latter two methods had the following advantages: collection efficiency of the EP may last longer, the power requirement of the MC and the MC' may be smaller, and the design for the complete collection system may be determined easily by measurement of dust particle diameter at the EP exit. For dust from the hearth, the efficiency of the system EP-MC was excellent because this procedure can collect about 60 to 70% of the dusts (paper flake and re-scattered dust within the EP) which are rather difficult to collect by the EP alone. The dust collecting system should be further refined according to the kinds of solid wastes.

15619

Barkov, N. N. and G. A. Kipanova

AUTOMATIC CONTROL OF A BOILER DUST SYSTEM WITH CYCLONE PRECOMBUSTION CHAMBERS. (Avtomaticheskoye regulirovaniye pylesistemy kotla s tsiklonnymi predtopkami). Text in Russian. Elek. Sta., no. 9:43-46, 1969. 4 refs.

The industrial adoption of installations for preparing pulverized coal using tangential hammer mills, industrial dust hoppers, and fuel drying with high-temperature flue gases has revealed the ineffectiveness of standard designs in the automation of these dust systems and has required the design of fundamentally new systems. The proposed control system would maintain a fixed production rate within plus or minus 1.0 ton/hr and the temperature of the dust-air mixture within plus or minus 2.5 C. It would provide a 25% improvement in productivity over manual control systems, as well as significantly reduce electrical power consumption for pulverizing and conveyance. Automatic control of the air-dust mixture with regulation of the flow rate of the drying agent assures maximum drying efficiency of the dust system. Supplying the temperature regulator with a signal characterizing the change in stoking rate assures stable stoking operations under conditions close to maximum crushing rate. An optimizing scheme which has a stoking rate control and a temperature stabilizing control would adequately allow for the technological characteristics of new dust systems and assure high operating efficiency.

16068

Schlachter, D. J.

REDUCTION OF STACK EMISSION THROUGH MODERNIZATION OF POWER PLANT FACILITIES. Preprint, Andrew Jergens Co., Cincinnati, Ohio, 13p., 1963.

A company's power plant operations were modernized to meet new emission standards by replacing a pulverized fired boiler with a boiler fired by a spreader stoker with a continuous moving grate. To achieve smokeless combustion, the boiler was equipped with pneumatic combustion controls, a tubular dust collector with section damper for low load operation, a convertible grate damper providing acceptable burning rates at both high and low loads, and overfire air jets and sidewall air jets for the proper mixing of fuel and air. Coal is mechanically distributed over the surface of the stoker grate by feeders equipped with rotor blades. The boiler satisfactorily meets steam load requirements of 50,000 lbs of steam/hr at maxium loads and 5000 lbs at minimum loads and simultaneously reduces stack emissions.

16366

Muermann, Herbert

DUST REMOVAL FROM FLUE GASES OF CENTRAL HEATING PLANTS. (Rauchgasentstaubung in Zentralheizungsanlagen). Text in German. Wasser Luft Betrieb, 12(1):11-13, Jan. 1968.

For the removal of dust in central heating plants, new two or four cyclone units have been constructed. They are of standard size with capacities of 1600 cu m/hr (two-cyclone unit) and 3200 cu m/hr (four cyclone unit). Several of these units can be combined to obtain the capacity required for each individual case. At nominal load and a flue gas temperature of 200 C, the pressure loss is 120 mm water. The entire height of the unit including the dust bin is just 2175 mm. Each unit has its own dust bin with a volume of 100 liters. They are sled into the units and closely interlocked so that no dust can escape. A diagram is given with which the adequately sized dust separator can be selected. The entire dust separation system comprises the separator which is directly connected to the boiler, a ventilator, flexible connecting pipes, baffles, and flue gas ducts. Larger dust separation systems catering to several boilers, the dust may be pneumatically transported to a common paper bag where the entire dust is collected.

16867

Safford, Donald

CLEAN BURNING OF RESIDUAL FUEL OILS. ASHRAE (Am. Soc. Heating, Refrig. Aircond. Engrs.) J., 11(4):41-43, April 1969. 2 refs.

Good combustion of fuel oil depends on the use of proper equipment selected on the basis of performance criteria. Operation should be possible at 15% CO2, No. 1 ½ Bacharach smoke, and 86% combustion efficiency. Exceptionally clean burning can occur with air at less than 5%. At these close to stoichiometric conditions, sulfur trioxide and nitrous oxides were reduced, resulting in less air pollution and extending equipment life.

17137

Flint, D., A. W. Lindsay, and R. F. Littlejohn

THE EFFECT OF METAL OXIDE SMOKES ON THE SO3 CONTENT OF COMBUSTION GASES FROM FUEL OILS. J. Inst. Fuel, 26(152):122-127, Sept. 1953 15 refs.

The present work was undertaken to provide quantitative data on the influence of various additives to the fuel burnt, as a method of decreasing the quantity of sulfur trioxide. Measurements were made with a dew-point meter on three relatively small oil-fired appliances. Two of these were sectional boilers and the third, on which most of the work was done, was a refractory furnace. Five oils, varying from a heavy fuel oil (3.5 per cent sulfur) to a gas oil (0.75 per cent sulfur) were burnt in the refractory furnace and a dew-point of the combustion products was in the range 250 to 300 F. Measurements on the gases from the heavy fuel oil, treated with soda residue (AS); calcium residue (AC); commercial zinc naphthenate (AZ), showed that the latter alone was successful in decreasing greatly the amount of SO3. Under good combustion conditions there was no acid dew-point when burning oil containing 0.14 per cent zinc (by weight). With 0.07 per cent zinc the amount of SO3 was still very low, a dew-point of 160 F being measured. (Author abstract modified)

17213

Muermann, Herbert

FLUE-GAS DUST EXTRACTORS. (Rauchgasentstaubung). Text in German. Wasser Luft Betrieb, 13(12):460-463, Dec. 1969.

Mechanical centrifugal-type dust separators of different designs for installation in medium-size and small boiler plants are discussed. The basic elements of a centrifugal separator are explained. In the last few decades, the flow- and the separation- processes have been formulated analytically and studied experimentally, leading to improved designs. A further development was the use of several smaller centrifugal separators (so-called 'battery cyclones') or of a large number of very small centrifugal separators (so-called 'multiclones'). The individual separators, of which a battery cyclone is composed, are made in different sizes, such as 400, 450, 500, 560, and 630 mm in diameter, and with volume rates of flow between 1200 and 4000 cu m/hr. These units can be assembled to take care of any specified gas input rate, while requiring a smaller overall amount of space than the conventional designs. By installing a system of guide vanes in the outlet duct for the cleaned gas, the energy associated with the angular momentom of the outlet gas can be recovered, thus rendering the pressure drop across the battery separator quite low. The multiclone is a high-performance separator consisting of many small parallel tubes with stationary internal vanes which impress on the dust-bearing inlet gas a rotary motion, so that the dust is separated from the gas by centrifugal force. These tubes are more effective, suffer less abrasive wear, have a lower flow resistance than the larger units, and can be installed and removed individually in separate locations. Standard tube modules, each with its own dust bin, offer many operational and economical advantages.

17905

McLaughlin, J. F. and J. Jonakin

SO2 TRAPPED IN FULL SCALE SYSTEM. Elec. World, 168(20):108-110, Nov. 13, 1967.

In order to determine the feasibility of removing sulfur dioxide and particulate matter from gases in a wet scrubber, a laboratory pilot plant was constructed and tested. A controlled amount of sulfur dioxide, additive, and fly ash was added to the stack gas of a natural-gas-fired boiler; the mixture was passed through a wet scrubber. The gas was sampled before and after the scrubber to determine the removal efficiency. The results are tabulated. Ninety-eight to 99% sulfur dioxide removal and 98 to 99.6% dust removal were obtained. The next phase of the investigation was conducted to determine whether or not the laboratory pilot data could be confirmed on a commercial size unit. In addition, furnace operating conditions during dolomite injection were studied. In the full-scale tests, dolomite was introduced to one furnace of a 325,000 KW, twin-furnace steam generator. Dolomite was injected in a sufficient quantity to react with all the sulfur dioxide produced when coals containing 2.8 to 3.8% sulfur were burned. The other furance was operated at the same firing rate and with the same fuel but without additive or scrubber. The results of the field tests are given. The data shows that sulfur dioxide removal can be maintained at a very high level (95% or better). Flow charts of the system are presented.

18118

CONTROL OF SO3 IN LOW-PRESSURE HEATING BOILERS BY AN ADDITIVE. J. Inst. Fuel, 42(337):67-74, Feb. 1969. 12 refs.

This paper deals with the burning of residual fuel oil containing 2.5% sulphur under conditions prevalent in heating boilers to assess the effect of boiler load, excess combustion air, mean residence time, and the use of a magnesia-alumina fuel-oil additive on the formation of noxious and corrosive products of combustion. Results show that the additive can be used as an effective substitute for low excess combustion air in reducing the emission of oxides of nitrogen and SO3. Futhermore, the additive neutralizes condensed H2SO4 and improves the electrical resistivity of soot particles to the point where electrostatic precipitation of soot is technically feasible. Detailed analyses of particulate matter samples taken from flames with untreated oil and oil treated with three different amounts of additive are described to elucidate the mechanism of acid soot neutralization and to obtain data on soot constituents that may contribute to atmospheric pollution. It is shown that the standard methods for measuring SO3 concentrations in flue gas can give misleading results when soot or particulate matter is present. (Author Abstract)

18149

Bell, W. J. and A. W. Overington

DUST RECOVERY IN THE KINLEITH BOILERHOUSE. Appita, 22(5):140-145, March 1969.

The equipment used to collect dust and ash from flue gases discharged by the five primary boilers firing oil, woodwaste, and coal consists of three separate dust recovery units. The first unit is rated at 110 air dried tons of pulp per day and is equipped with an ash hopper between the boiler and cyclone and an electrostatic precipitator after the cyclone for collection of saltcake and other dust from the flue gases. The precipitator has two fields with square wire emitters and plate collectors with 60 kv applied between them. Collection efficiency is between 75 and 95%. The second recovery unit is rated at 110 air-dried tons of pulp per day and is equipped with an ash hopper, a venturi scrubber, and a black liquor evaporator after the boiler. The venturi scrubber handles 60,000 cu ft/min of flue gases at 700 F. Differential pressure over the venturi is between 28 and 33 in H2O gauge, depending on black liquor viscosity and operating rates. Saltcake collection efficiency is 80%. Number three unit is rated at 250 air dried tons of pulp per day. It has a cyclone evaporator and an electrostatic precipitator after an economizer. Black liquor at 45% solids is sprayed into the hot flue gas at 630 C from the economizer just before the cyclone. The 70,000 kv, 500 ma, two stage precipitator is designed to handle gases at 105,000 cu ft/min and between 230 and 375 F. Collection efficiency is 99%.

18290

Thomas, S.

'CLEAN AIR, COAL AND THE ENGINEER'. Certificated Engr., 42(4): 91-116, April 1969.

A comprehensive picture of coal combustion as it affects atmospheric pollution and its relationship to the Atmospheric Pollution Prevention Act is presented. Coal burning boilers often violate the Act, which states that smoke emissions shall be no darker than No. 2 of the Ringelmann Chart. The various methods of firing solid fuels and the several types of combustion fuel beds used are described. Also presented is a detailed discussion of the industrial fluidized bed boiler. This method eliminates CO from the exit gases and eliminates fly ash-fouling. The addition of small amounts of dolomite retains all sulfur compounds. Control equipment used in the retention of SO2 from stack gases is reviewed.

18296

Larsson, Olov

DIMENSIONING OF FLUES AND RUNNING CONDITIONS IN MEDIUM-SIZED HEATING PLANTS. (Rokkanalers dimensionering och driftforhallanden i medelstora panncentraler.) Text in Swedish. National Swedish Building Research (Statens Byggforskningsinstitut, Stockholm, Sweden), 1969. 5 refs.

The National Swedish Institute for Building Research has conducted a field study of both old and new heating plants in the southern and central parts of Sweden with maximum effects varying from 200 to 8200 Mcal/h. All plants were fired with oil fuel, classes 3 or 4 (some with class 4 which contains little sulphur). The overwhelming majority of the plants were equipped with welded boilers, while 75% of the oil burners are of the pressure jet or emulsion burner types, 18% low air pressure, and the rest had rotary burners. Approximately 50% of the heating plants studied have natural ventilation units and about 30% of those heating plants studied have natural ventilation units and about 30% of those plants with mechanical ventilation (flue gas fan) have separate flues leading from each boiler to the mouth of the chimney. The concentration of solid matter in the flues was measured for different boiler loads and the amount of matter per kg of fuel oil was calculated. Temperatures of flue gases, amounts of soot, velocity of flue gases, static pressure, excess air, and temperature of internal walls were also measured. The mean for the concentration of solid matter at all tests averaged about 74 mg/cu m. Flue gases, while the corresponding mean for the amount of solid matter present was 1.7 g/kg fuel oil. The usual estimate for the CO2 content in the flue gases is 12-14%, at which level 74 mg/cu m would correspond to 1.0 g/kg of fuel oil. The survey showed, however, that such high CO2 contents rarely occur at the point where the content of solid matter is measured. The mean for the CO2 content in the plants studied was 7.5%. Only a small number of the plants tested had chimneys whose heights with regard to the amount of flue gases emitted and to the sulphur content in the oil were in accordance with the advice and instructions published by the authorities. Measurements of soot quantities according to Bacharach show that only about 35% of the boilers have Bacharach number 3 or less. Measurements showed that about 80% of the plants had, under normal running conditions, flue gas temperatures lower than 145 C at the mouth of the chimney. About 30% of the plants had flue gas temperatures lower than 100 C. The report also describes the velocity of flue gases, total amount of air leakage and damages caused by corrosion.

19056

Sensenbaugh, J. D.

FORMATION AND CONTROL OF SULFUR OXIDES IN BOILERS. J. Air Pollution Control Assoc., 12(12):567-569, 591, Dec. 1962. 32 refs.

During combustion, sulfur present in commercial fuels is converted to sulfur oxides, which cause corrosion and deposit formation within the boiler and are emitted from the stacks. The flue gas concentration of sulfur dioxide is generally 0.1 to 0.25% by volume. Iron oxide on boiler surfaces and deposits containing certain ash constituents can catalyze the oxidation of SO2 to sulfur trioxide. Removal of sulfur from fuels would be the ideal solution to air pollution prevention. However, this is not possible due to economic limitations. There are a number of processes for removing SO2 from stack gases. Several scrubbing processes, such as the non-regenerative limestone process, the regenerative sodium sulfite process, and the ammoniacal liquor process have been investigated. There is also a direct ammonium sulfate process in which SO2 is catalytically oxidized and neutralized with ammonia in the scrubbing solution. Adsorption, absorption, and catalytic oxidation with metallic oxides have also been studied. Removal of SO3 from stack gases by means of additives has been accomplished in some cases. Economic justification may be provided by alleviation of corrosion and deposit formations.

19257

Maeda, Isamu and Nobuo Ito

AN APPARATUS FOR THE CONTINUOUS RECOVERY OF SULFUR OXIDES IN FLUE GAS. (Haigasu chuno iosankabutsu renzoku kaishusochi). Text in Japanese. (Sumitomo Machine Industries, Osaka (Japan)) Japanese Pat. Sho 45-2644. 2p., Jan. 29, 1970. (Appl. April 28, 1967, claims not given).

An improved conventional method of recovering sulfur oxides from flue gas is presented which can be applied to flue gas from boilers, smelting or metal-sintering processes, or pulp manufacturing. Since the sulfur oxides concentration in flue gas is extremely low and volume of flue-gas to be processed is extremely high, the gas was previously passed through absorbents from which the sulfur oxides were recovered. The process required rinsing with inert gas, H2, CO, water, or alkaline solutions. Consequently, generators and circulators for those gases and liquids were necessary. In the present process, however, the major part of the flue gas is cooled to the temperature appropriate for adsorption and subsequently led to a continuous adsorption apparatus, where the sulfur oxides are adsorbed. The remainder of the gas by-passes the cooling chamber. After the removal of the remaining oxygen, the gas is led to a de-adsorption chamber and sulfur oxides are recovered. The system requires no inert-gas generators or gas heaters. Moreover, since a moving-layer adsorption system is empolyed, less adsorbent is needed. Also, the concentration of the recovered gas is more uniform than that covered by previous processes.

19453

Toelle, Juergen

DUST COLLECTORS FOR BOILER FIRED WITH ASH-RICH HARD COAL. (Entstaubungsanlagen an Dampfkesseln mit Feuerungen fuer aschereiche Steinkohle). Text in German. Technik Forschung, 11(48):171-172, 1968.

The Technical Directives for the Maintenance of Clean Air have set maximum allowable dust concentrations of 0.5 g/standard cu m (long term operation), for waste gases from boilers and of 0.15 g/standard cu m for each newly built plant. For boilers fired with pulverized hard coal, high-efficiency electrostatic precipitators with a collection efficiency of 99.7% murt be installed to meet these limit values. Any design of electrostatic precipitators must take into account the dust quantity in the gas flow to be cleaned, particular properties of the dust and gas, primarily the electric conductivity of the dust and its tendency to agglomerate, the temperature of the waste gas, its moisture and sulfur trioxide content. A horizontal version of the precipitator is used for such plants with two separate rapping devices for the primary and secondary dust collection zones. The most favorable rapping rhythm must be experimentally determined in each individual case.

19469

Woollam, J. P. V. and A. Jackson

THE REMOVAL OF OXIDES OF SULPHUR FROM EXIT GASES. Trans. Inst. Chem. Engrs. (London), vol. 23:43-51, 1945. 33 refs. (Presented at the Institution of Chemical Engineers North Western Branch Meeting, Manchester, England, March 17, 1945.)

A process is described for removing sulfur dioxide and trioxide from the exit gases of contact acid plants, boiler installations, and smelting processes. It consists of scrubbing the gases with a solution of ammonium sulfite, bisulfite, and sulfate mixture, keeping the pH value at a predetermined figure by the addition of aqueous ammonia, and bleeding off the make of solution to an autoclave where it is heated with steam to form ammonium sulfate solution and sulfur. On the basis of encouraging preliminary tests, a large-scale process facility was built at a contact acid plant. Testing and results are given in detail, and permit definition of the limits for optimum conditions. The SO2 and SO3 present in the exit gases can be reduced to less than 5% of their original value, and the price of the ammonia feed can be reduced to 60% of that for the pure 25% ammonia by the use of 18-20% concentrated gas works liquor. Two applications of the process are briefly discussed: acid plant exit gas treatment, and 'devil gas' treatment with reference to a 15% hydrogen sulfide gas mixture.

19473

Johnstone, H. F.

METALLIC IONS AS CATALYSTS FOR THE REMOVAL OF SULFUR DIOXIDE FROM BOILER FURNACE GASES. Ind. Eng. Chem., 23(5):559-561, May 1931. 7 refs.

The use of metallic ions as catalysts for the absorption of sulfur dioxide from stack gases was investigated. Air containing 0.325% SO2 was passed at a constant rate through three liters of water containing the catalyst. The catalyst concentrations varied from 0.028 to 4.2 g/l of the metallic ion. In concentrations as low as 0.0028%, manganese ions exert a strong catalytic action, increasing the capacity of the water for absorbing SO2 by 600%. The catalytic effect of ferric ions is less than that of manganese. Definite promotor action is shown when a small concentration of manganese is added to dilute ferric solutions. A trace of copper ions inhibited the action of manganese in any concentration, but they had no effect on catalysis by ferric ions. The presence of zinc, nickel, chromium, or alkali metal ions neither inhibits nor promotes the catalysis by manganese ions. Application of the laboratory results was made with a small single-effect rotary scrubber. Although the efficiency was much lower than that of the laboratory scrubber, it compared favorably with that obtained by other large-scale methods.

19588

Leigh, James Harrison

IMPROVEMENTS RELATING TO THE TREATMENT OF BOILER FLUE GASES. Simon-Carves Ltd., Stockport (England)) British Pat. 525,883. 1p., Sept. 6, 1940. (Appl. Jan. 12, 1940, 1 claim).

A process for removing sulfur compounds from boiler flue gases and converting them into a salable product is described. The gases are washed with an ammoniacal liquor which is then heated under pressure in an autoclave. Sulfur compounds are converted into ammonium sulfate which is crystallized by evaporation and recovered. The temperature in the autoclave is about 190 C and the pressure should not exceed 200 lbs/sq in. This process is economical and does not involve high pressures in the autoclave. No preliminary treatment is needed to ensure a low temperature and pressure to produce the desired reaction.

19642

Land, George W., Eino W. Linna, and William T. Earley

CONTROLLING SULFUR DIOXIDE EMISSIONS FROM COAL BURNING BY THE USE OF ADDITIVES. Preprint, Air Pollution Control Association, New York City, 33p., 1969. 4 refs. (Presented at the Air Pollution Control Association Annual Meeting, 62nd, New York, June 1969, Paper 69-143).

A project is reported in which 20 tests with five coal additives - dolomite chips and pulverized dolomite, hydrated lime, aragonite (a high-calcium limestone), red mud (an aluminum by-product high in iron oxide), and a proprietary liquid combustion catalyst - were run in an operating industrial boiler plant to study their effects on sulfur dioxide emissions. The test unit was a 750-HP Wickes boiler fired by a multiple-retort underfeed stoker. Two methods were used: the additive was either mixed with the coal before it was fired, or was injected with compressed air jets over the fire. Sampling techniques for suspended particulates, using a gravimetric sampling train, and for SO2 in the stack gases, are described. Results are presented and discussed; in general they were anomalous, and because the tests were limited in scope and subject to numerous uncontrolled variables, no conclusions are drawn. The results do however, indicate that SO2 emissions from coal burning can be significantly reduced by the use of certain additives, and that further studies are warranted.

19729

Chertkov, B. A.

EFFECTIVENESS OF FLY ASH REMOVAL FROM FLUE GAS IN A FOAM BUBBLER. (Effectivnost' ochistki dymovykh gazov ot letuchey zoly v pennom barbotazhnom apparate). Text in Russian. Teploenergetika, 6(8):58-62, Aug. 1959. 4 refs.

A four-tray foam bubbler was used to remove fly ash from flue gases of a 160-200 ton/hr boiler, fly ash content being 5-8 g/ cu m. Volumetric gas flow rates of 6000, 10,000, and 13,000 were studied with linear flow rates ranging from 1.4-3.05 m/sec. Efficiency was 97.5-98.8% at the higher flow rates. Total flow resistance of the bubbler averaged 160 mm H2O for a linear flow rate of 3 m/sec. Sulfur dioxide content of the discharge water varied from 0.35 to 0.70 g/liter, while acidity ranged from 6.2 to 9.8 mg-equiv/mole liter.

20035

Johnstone, H. F.

THE ELIMINATION OF SULPHUR COMPOUNDS FROM BOILER FURNACE GASES. PART I. Steam Eng., 1932:153-154, Jan. 1932. 5 refs. PART II. Ibid, 1932:208-211, Feb. 1932. 1 ref. (Presented at the Third International Conference on Bituminous Coal at the Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 1931.)

Methods for removing sulfur dioxide from flue gases are reviewed with particular attention to scrubbing in the presence of a cayalyst; promising results with iron and manganese compounds are reported. Experiments were conducted with 0.325% SO2 in air bubbled through 2 liters of water and a cayalyst at a rate of 0.7 cu ft/min; contact time was no more than 4 sec. Inhibitory effects of phenols, salts of copper and tin, and hydrogen sulfide in concentrations of more then 0.2% in the gas were noted. Additional studies were made to determine the effects of catalyst concentration, temperature, and presence of inhibitors on scrubber efficiency; in this case, contact time was reduced to 3 sec. The iron catalyst was found to be less affected by inhibitors than manganese. A 100 cu ft pilot scrubber was operated with an initial SO2 concentration of 0.1% and a contact time of 0.05 sec; 270 gal of water per ton of coal were required.

20294

Celayan, Genaro G.

SMOG-CONTROL EQUIPMENT FOR INTERNAL COMBUSTION ENGINES, INCINERATORS AND BOILERS. (Assignee not given.) U. S. Pat. 3,499,282. 7p., March 10, 1970. 7 refs. (Appl. Oct. 13, 1967, 6 claims).

Smog control devices which eliminate volatile matter, carbon monoxide, and hydrocarbons from the exhausts of internal combustion engines, home incinerators, and boilers are described. An elongated chamber has an air inlet and an exahust gas inlet at one end, with a series of butterfly vanes mounted for rotation along the length of the chamber. A spark-plug between each adjacent pair of butterfly vanes ignites the exhaust gas and air mixture as it passes along the length of the chamber. By means of the vanes, the chamber is divided into a number of separate blast chambers. The spark plugs provide a repetitive spark to give each blast chamber a source of heat energy to burn the volatile matter in the exhaust gases. As the vanes turn under the influence of moving gas, they permit the passage of the gas from one blast chamber to another where the remaining volatile matter is reduced and the CO gases are eliminated. Eventually, the processed gas passes from the last blast chamber and is then exhausted into the atmosphere.

20539

Coutant, R. W., R. E. Barrett, and E. H. Lougher

SO2 PICKUP BY LIMESTONE AND DOLOMITE PARTICLES IN FLUE GAS. Preprint, American Society of Mechanical Engineers, New York, 9p., 1969. 7 refs. (Presented at the Winter Annual Meeting of the American Society for Mechanical Engineers, Los Angeles, Calif., Nov. 16-20, 1969, Paper 69-WA/APC-1.)

An investigation was made of the reaction between sulfur dioxide and limestone and dolomite particles in flue gas. Reaction data were generated by exposing the particles to localized boiler- furnace conditions. Variables included in the study were residence time, temperature, particle size, SO2 concentration, and chemical state of the stone. A model is hypothesized for the SO2-particle reaction that is consistent with the experimental data. The hypothesis states that the initial reaction products are sulfites, and that as the particle temperature rises above 1400 F, SO2 is lost by the thermal decomposition of the sulfite. Concurrent with these steps, the sulfite can be oxidized and/or disproportionate to form sulfate. The net result is a maximum in sulfur pickup during the first second of exposure in the reactor. (Author abstract modified)

20563

Zubik, B.

INTRODUCTORY PROJECT UNDER CONTRACT WITH THE U. S. A. CONCERNING COOPERATION IN RESEARCH ON DESULFURIZATION OF COMBUSTION GASES. (Projekt wstepny umowny z USA o wspolpracy w zakresie badan nad odsiarzaniem spalin). Preprint, 9p., 1968 (?). Translated from Polish. Franklin Inst. Research Labs., Philadelphia, Pa. Science Info. Services, 12p.

The Fuels Department of the Power Metrology Research Organization 'Energopomiar' has the following divisions: Fuels

Analysis, Fuels Technology, Research on Air Pollution, and Desulfurization of Combustion Gases. The research theme, 'research into the effect of introducing dolomite into boiler on the disposition of coals to form deposits on the heating surfaces', the objectives of the research, significance of the search, work schedule, time schedule, description of work, deadline, research in experimental and service conditions, the points the research will cover, the number of people and salaries involved, and costs of equipment to be acquired for the three year project are outlined. Specifically, the research will permit wider application of the method of desulfurization of the boiler combustion gases, based on introducing dolomite into the combustion chamber and determining the effect of intermittent or continuous introduction of dolomite into boilers which fire specified kinds of coal.

20616

Brandt, Herbert

STABLE BACK DISCHARGE IN ELECTROSTATIC PRECIPITATORS. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(8):21-22, Aug. 1969. 1 ref.

A study of 14 large precipitators for fly ash removal from steam boiler furnaces indicated that the voltage peak in the 42 high- voltage fields of the precipitators varied from about 300 to 1500 mA at fluctuating current intensities. Though back discharge set in at the voltage peak and increased with rising current, the process was obviously stable and did not cause a substantial reduction in efficiency. Neither did it correspond to theories that assume that electric breakdown in the dust layers reverse the ionization effect on the dust quantities and drive them back to the discharge electrodes. To understand back discharge phenomena, the process was simulated in laboratory experiments in which the dust layer was replaced by nylon fabric above Teflon foils. Blue light cones appeared between approximately 5% of the discharge electrode points and the foil. No flashovers occurred in the fabric or foil. When flashovers were induced by adjusting the voltage and making small holes in the insulating layer, they occurred not in the light cone but adjacent to it and at more distant electrodes. A photograph clearly indicated the luminescence of the excited ions; the space charge at the light cone was greater because of the intense ionization. The results thus indicate why flashovers from point wires occur at higher voltages than from radial or strip wires.

20758

Christman, John R.

HEAT GENERATOR. (Assignee not given.) U. S. Pat. 3,485,191. 2p., Dec. 23, 1969. 7 refs. (appl. Feb. 8, 1968, 4 claims).

A boiler with a heat exchanger and chimney is located over a firebox with a radiation core and designed to discharge only completely burned combustion products to the atmosphere. In operation, the products of combustion travel from the firebox, up an updraft duct, and to the chimney. Any incompletely burned products are directed by baffles to manifolds for collection and then pulled back to be reburned by the action of a suction blower drawing the products through feed ducts and against the radiation core, where they are reburned and begin the cycle over again.

20777

Tamura, Zensuke and Yukio Nishinuma

A PROCESS AND APPARATUS FOR THE DESULFURIZATION OF INDUSTRIAL WASTE GASES. (Hitachi, Ltd., Tokyo (Japan)) U. S. Pat. 3,486,852. 6p., Dec. 30, 1969. 4 refs. (Appl. Sept. 21, 1967, 20 claims).

A process and apparatus for desulfurizing industrial waste gas and recovering sulfuric acid as a byproduct are described. A portion of the waste gases are introduced into an adsorption tank to remove the sulfur oxides by contacting them with active carbon, while the remaining portion is sent to a region for drying the active carbon which has been wet in a preceding rinse-desorption step. From the drying tank the gases are led to the adsorption tank. Waste gases free of sulfur oxides are released to the atmosphere from the adsorption stage. Sulfur oxides are removed from the active carbon by rinsing with water, and the washings are removed and sent to a concentration tank where they are heated and sulfuric acid is recovered. The functions of the respective regions is the adsorption-desorption apparatus are shifted one after another at a certain time interval, so that a cycle of operation consisting of adsorption, rinsing-desportion and drying, is carried out concurrently repeatedly.

20822

Aoki, Toyohiko

APPARATUS FOR PURIFYING POLLUTED GAS. (Naigaikogyo Kabushiki Kaisha, Tokyo (Japan)) U. S. Pat. 3,479,799. 9p., Nov. 25, 1969. 9 refs. (Appl. March 10, 1967, 2 claims).

A device for purifying polluted gases from factory equipment, heaters or burners, and internal and external combustion engines is described. The polluted gas is sent to a perforated rotary drum where it is contacted with a liquid. The gas and liquid are passed through the perforations of the drum and then dispersed by centrifugal force produced by the high speed rotation of the drum. The gas is then mixed with the liquid, and the fine particles and harmful elements in the gas are positively transferred into the liquid. The purified gas and the liquid are separated in a cyclone. The liquid is sent to a storage area where the particulate matter is removed, and is then conveyed back to the contact mechanism.

21195

Montgomery, William T. S.

BOILER FUEL RECLAMATION SYSTEM. (Jacksonville Blow Pipe Co., Fla.) U. S. Pat. 3,489,111. 11p., Jan. 13, 1970. 3 refs. (Appl. Oct. 6, 1967, 14 claims).

In many industrial operations, boilers are fueled by burning bark which is often obtained from trees growing in sandy country where the bark grows over the sand so that the sand permeate throughout the bark. The sand is carried about by hot gases within the boiler firebox and is caught in the dust collectors catching the char and is then reinjected into the firebox of the boiler along with the char. The boiler fuel reclamation system includes a separator for removing sand from fly ash charcoal in a wood or bark burning boiler and a novel system for employing stack gas or air to convey sand or fly ash charcoal through the separator and for returning the charcoal to the boiler firebox. A programmed double dump valve unit facilitates the gravity discharge of light sand and fly ash charcoal from the low pressure area of a collecting hopper into the high pressure area of a gas conveying tube. (Author abstract modified)

21200

Mueller-Wartenberg, Heinz

APPARATUS FOR CARRYING OUT A METHOD OF PURIFICATION FOR FLUE GASES. (Metallgesellschaft A. G., Frankfurt (W. Germany)) U. S. Pat. 3,475,133. 14p., Oct. 28, 1969. 6 refs. (Appl. Dec. 30, 1965, 9 claims).

An apparatus is proposed for a multi-stage method of purifying flue gases which contain sulfur compounds, particularly the flue gases of oil- or coal-fired boilers. After the gases have been previously treated in coolers and scrubbers and had the dust removed from them in mechanical or electrical dust precipitators, they are subjected to a wet catalysis with coal or carbon as the catalyst in order to remove the sulfur-containing compounds, particularly sulfur dioxide. The cooler and/or scrubber, and, if employed, the dust precipitator are arranged vertically one above the other with catalyst reaction beds in a tower-like common housing of prefabricated plates forming a closed gas shaft. The gas shaft is divided up vertically into a series of flues by a series of superimposed catalytic reaction beds and run-off trays which form barrier walls. The reaction beds are staggered vertically in a staircase-like manner so that they are shifted with increasing length into the oncoming flow of gas. The lateral offset provides an upwardly decreasing flow area on the inlet side of the beds and an upward increasing cross-sectional flow area on the outlet side of the beds. The lower part of the gas shaft forms an acid or fluid collecting container.

21268

Spaite, Paul W. and Robert P. Hangebrauck

HEW SPELLS OUT AIR-QUALITY GOALS. Elec. World, 173(20):25-27, May 18, 1970.

About half of the air pollution from industrial and commercial activities is produced by the burning of coal, oil, and natural gas. The emissions originate in power plants, industrial boilers, and small installations used for commercial and residential heating. Power production, which accounts for 70% of the total sulfur oxides emissions from combustion, is the most important source. Power plants also account from 30% to 40% of all nitrogen oxides emissions. Particulate emissions appear to be less critical than SOx or NOx, but this may be misleading because particles less than 1 micron in size are not accounted for. Conventional electrostatic precipitators can reduce the emissions slightly, but the number of fine particles will increase by a factor of four between 1970 and 2000. Control of SOx emissions by flue-gas cleaning should soon be practicable. The 'throwaway' processes, which involve reacting SOx with limestone, to be collected as calcium-sulfur in precipitators or wet scrubbers, are most likely to find application. Reliable methods must be developed for controlling NOx emissions from boilers. Electrostatic precipitators could control much of the fly ash, but many of those operating today function inefficiently because they were designed for less stringent requirements or have lost efficiency. There is a critical need for improved systems and techniques for controlling submicron particles.

21328

Shirasawa, Tadao

FUEL, COMBUSTION, AND PREVENTION OF DUST AND SMOKE (PART 9). (Nenryo nensho to baienboshi (sono 9). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 6(5):299-306, May 25, 1970.

British investigators sucessfully utilized tertiary air to inhibit the production of dust and smoke. A small conventional under-feed stocker was employed for the boiler. Five different methods were tested for the effects on dust and smoke generation: (1) total air required for combustion was supplied as a primary air when the fuel was fed to the boiler; (2) the supply of primary air was continued, the supply of fuel was stopped; (3) in addition to the primary air, secondary air was blown into the combustion chamber from back; (4) in addition to the primary air, the secondary air was continuously supplied from a nozzle provided at the fuel intake; and (5) total air required was supplied as primary air. The third method was most effective from the viewpoint of dust and smoke prevention. The relationship between the tertiary air intake and the size of the combustion chamber mixing zone, is discussed, and the results are presented of another study on air injection and combustion-chamber space.

21506

Johnstone, H. F.

METALLIC IONS AS CATALYSTS FOR THE REMOVAL OF SULFUR DIOIXDE FROM BOILER FURNACE GASES. Ind. Eng. Chem., vol. 23:559-561, May 1931 7 refs. (Presented at the American Chemical Society Meeting, Division of Industrial and Engineering Chemistry 81st., Indianapolis, Ind., March 30-April 3, 1931.)

A method to remove sulfur dioxide from stack gases is described. The method involves increasing the solubility of SO2 in water, or aqueous solution, to such an extent that the amount of water required for the removal of SO2 from gases containing very small concentrations of this constituent would be reduced to a point where the process would be economically and mechanically feasible. The capacity of water for absorbing SO2 may be increased by introducing a catalyst to hasten the reaction between the dissolved gas and oxygen. An experimental procedure using metals and metal sulfates as catalysts is described, and test results are given.

21893

Lowicki, Norbert, Gernot Hanig, and Klaus Husmann

THE - WASTE GAS - SULFUR - PROCESS. REPORT ON THE DEVELOPMENT OF A PROCESS FOR THE REMOVAL OF SULFUR FROM FLUE GASES. Grillo-Werke A. G., Duisburg-Hamborn (West Germany), Oct. 1969. Translated from German. Belov and Associates, Denver, Colo., 68p., March 30, 1970.

The difficulty of the removal of sulfur from waste gases varies according to the origin of the waste gas. Waste gases of steam boiler plants precipitate rather uniformly with respect to quantity temperature, and composition. On the other hand, sinter waste gases contain additional metal oxide smoke which can complicate the process of sulfur removal. Thus, the process selected should have no sensitivity to disturbing gas components and should have versatility with respect to the absorption of any of the sulfur compounds coming under consideration. A desulfurization process was developed which is an absorption process with thermal regeneration of the charge absorbent. The process principle selected is based on the reaction of oxide compounds between a basic and an amphoteric heavy metal component. The presence of a compound Mg6MnO8 has been proven using X-ray structure investigation; the presence of a compound Mg3MnO5 is also probable. In this combustion, the basic component is used as the actual absorbent and the heavy metal component as the oxygen donor. This has the effect of increasing the total activity of the mixture. For the same reason, the absorption of hydrogen sulfide from waste gas is also made possible. In the thermal regeneration of the charge mass, both components protect each other reciprocally against deactivation. Economic aspects were a primary consideration in the selection of the desired components for the absorption mass. This eliminated elements like Cr, V, Mo, and Zn. Though Ca and Mg were practical, Fe and Mn were selected because of the rapid formation and stability of the oxide compounds between them as well as the inactivity during absorption. All chemical and process-technological predictions made on the basis of laboratory experiments were confirm. For oil-fired steam boiler plants, flue gas desulfurization plants ready for practical use can be set up and operated. Capital outlays and operational costs are given for an oil-fired 300 MW power plant, in addition to total annual operational costs. A particular advantage of this process is that the charge mass can be regenerated by various desulfurization systems at a central location.

22071

Douglas, Jack

INSTRUMENTS AND CONTROLS FOR INDUSTRIAL POWER PLANTS. Nat. Eng., 73(7):10-12, July 1969. (Presented at the Industrial Fuel Oil Conference, 7th, of the Illinois State Association, National Association of Power Engineers, Chicago, Ill., May 21, 1969.)

Large power plants have long known the importance of carefully designed combustion control systems. The need to reduce air pollution and operational costs now requires similar control planning on the part of small boiler installations. Automatic draft controls should be provided for pressurized boilers, in which pressure at the boiler exit tends to vary with burner firing rates. Such controls make it possible to maintain relatively constant boiler output pressure or temperature, thus insuring proper air/fuel ratios for efficient combustion. Equally important is the boiler's utilization of the heat generated. All steps of steam generation should be checked by a flue temperature gauge which shows the degree to which the boiler has absorbed the heat generated. Another measure of boiler efficiency is the amount of oxygen in the flue gas. Reliable paramagnetic instruments are available for these measurements. Finally, master lead-lag sequence controllers, which treat all boilers as one in supplying the load demand, should be provided in multiple boiler installations. These devices increase the life of packaged boilers and eliminate the need for constant human monitoring.

22559

National Academy of Sciences, Washington, D. C., Federal Construction Council

IMPACT OF AIR POLLUTION REGULATIONS ON FUEL SELECTION FOR FEDERAL FACILITIES. Contract CST490, TR-57, 52p., 1970.

Results of a report to determine the extent to which current and anticipated air pollution regulations will restrict the types of fuel which Federal agencies will be allowed to burn in steam- power and central heating plants are described. Procedures to be used in taking account of such restrictions in economic analyses to determine the type of fuel to burn are included. Three fossil fuels- coal, oil, and gas- are evaluated regionally from the standpoint of availability, quality, and price. Types of emissions which are considered include smoke, particulates, nitrogen oxides, and sulfur oxides. Control equipment to remove sulfur oxides is not to be considered by Federal facilities unless there is no other alternative. Existing and anticipated air pollution control regulations for the nation are presented.

22603

Meier-Hedde, Otto

IMPROVEMENT OF BOILER OPERATION BY MEANS OF FUEL ADDITIVES. (Besserer Kesselbetrieb durch Wirkstoffe im Heizoel). Text in German. Erdoel Kohle (Hamburg), 21(9):558-561, Sept. 1968. 12 refs.

The liquid additive Bycosin was added, usually before filling, to fuel oil tanks at the rate of 1:2500 - 1:5000 and carefully mixed. This not only resulted in improved efficiency of boiler operation but also eliminated molten ash and acid soot flakes, while substantially reducing corrosion, at both high and low temperatures The effect of the additive on the behavior of sulfur and vanadium compounds in the fuel is discussed.

22903

Lenz, W.

THE PRESENT STATE OF DEVELOPMENT OF OIL-FIRING EQUIPMENT FOR HIGH-DUTY BOILERS. (Der heutige Entwicklungsstand der Oelfeuerungen fuer grosse Kessel). Text in German. Mitt. Ver. Grosskesselbesitzer, 49(2):86-92, April 1969. 1 ref.

Development work is proceeding on oil-firing equipment with an oil consumption exceeding 10 tons/hour per individual burner. Atomizer working on 3 atomization principles based on centrifugal force, on pressure, and on atomizing agents which all result in near stoichiometric combustion are described. An innovation in centrifugal atomizers is oil supply delivered directly into the fast rotating atomization cup. Pressure atomizers work always with a swirl nozzle because atomization with a hole-type nozzle yields too narrow a stream for intimate mixing with air. Atomizers working with atomizing agents use steam or compressed air depending on cost considerations but mostly steam. Air supply heads insure ignition by intimate mixing of the oil fog with air. Air can be supplied with or without a nozzle. A low level of excess air requires high air velocity in order to insure good mixing. The venturi parallel stream head works without a nozzle and gives a long flame. The construction of the Steinmueller head supplies air of constant velocity. To stabilize the flame at high air velocities, so-called impellers or ignition screens are used. The toroidal burner developed by Shell works on the prinicple of return feeding of hot flue gases. Rotating self-cleaning filters are used with oils of high solid matter content. Gas-electric ignition burners with infrared or ionization control devices are used to effect ignition Measuring and regulatory devices designed to insure near stoichiometric combustion in a sharply fluctuating operation, safety devices, and devices insuring semi-automatic or automatic operation of oil firing equipment are described.

23063

Glaubitz, F.

THE ECONOMIC COMBUSTION OF SULFUR-CONTAINING HEATING OIL. PART II- AN ACCOUNTING OF THE OPERATING EXPERIENCES WITH 1.0 PER CENT EXCESS AIR. Combustion, 34(9): 25-32, March 1963. (Presented at the VGB (Ver. Grosskesselbesitzer), 'Oil Furnaces' Meeting, Lingen, Germany, April 12, 1961; printed in Mitt. Ver Grosskesselbesitzer, no. 73, Aug. 1961.)

A combustion process which employs a very low excess air and flue gas oxygen content is described to control corrosion. The use of sulfur-containing fuel can lead to corrosion by sulfuric acid because of the relationship between dew point, oxygen content, and sulfur content of the fuel. Experimental measurements carried out on boilers indicate the optimum quantities of various combustion parameters in terms of economics, deposits, and continuous operation time. Development of the optimum system is described, and detailed discussions of various problems encountered with different types of boiler arrangements are discussed. Results of firing experiments with superheating are tabulated.

23073

Ward, J. J., D. A. Pettit, J. F. Walings, R. H. Cherry, Jr., A. Levy, and William T. Reid

FUNDAMENTAL STUDY OF SULFUR FIXATION BY LIME AND MAGNESIA. (FINAL REPORT.) Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Contract PH 86-66-108, 55p., June 30, 1966. 23 refs. CFSTI: PB 176843

The basic factors involved in the capture of sulfur dioxide by limestone or dolomite addition into the hot stack gases of a boiler furnace are identified. The limiting conditions under which lime and magnesia will react with SO2 to form calcium and magnesium sulfates are defined. The three tasks involved in the study are thermodynamic calculations to show the course of the probable chemical reactions, determining kinetic factors as far as they can be without experimentation, and making recommendations for the use of limestone and dolomite most effectively in large boiler furnaces. Theoretical calculations indicate that calcium oxide or magnesium oxide is capable, at equilibrium, of removing all but 1 ppm of SO2 at a specified temperature. Large amounts of limestone or dolomite are necessary to remove SO2 flue gases. Temperature and other critical operating parameters are discussed.

23176

Jimeson, Robert M.

CENSUS OF FEDERAL COAL RESEARCH GIVEN AT SALT LAKE CITY MEETING. Mining Engineering, 15(11):51-55, Nov. 1963.

About 50% of coal consumption in the United States is in the production of electric power, 20% in the production of metallurgical coke, and over 20% in the production of process steam and power. The U. S. Bureau of Mines' Division of Coal Research places much emphasis on research that will maintain coal's leadership in these established areas. This emphasis is reflected in the following projects now underway: the possible utilization of a coal-fired turbine in conjunction with conventional boilers; the removal of dust from coal-generated gas by an electrostatic precipitator operating at turbine conditions; conversion of coal and coal gases in plasma; conversion of coal to high-Btu gas by direct hydrogenation and catalytic methanation; the application of nuclear process heat to the gasification of coal; purification of synthesis gas for high-Btu pipline gas; four types of reactor systems for catalytic hydrogenation of carbon monoxide; magnetohydrodynamic generation of power from coal; entrained carbonization processes for the production of char from coal; and the use of coal as a supplemental fuel for blast furnaces. The current status of these projects is outlined.

23189

Oparin, V. V.

PURIFICATION OF ATMOSPHERIC AIR OF CONTAMINANTS FROM INDUSTRIAL DISCHARGES. In: American Institute of Crop Ecology Survey of USSR Air Pollution Literature. Effects and Symptoms of Air Pollutes on Vegetation; Resistance and Susceptibility of Different Plant Species in Various Habitats, In Relation to Plant Utilization for Shelter Belts and as Biological Indicators. M. Y. Nuttonson (ed.), vol. 2. Silver Spring, Md., American Institute of Crop Ecology, 1969, p. 1-5. (Also: Akad, Nauk SSSR Ural. Filial. Komis. po Okhrane Prirody. Rastitel' nost' i promyshlennye zagryazneniya. Okhrana prirody na Urale. V (Sverdlovsk), 1966, p. 7-10.) Significant work on an overall solution to air pollution control in the Ural industrial areas was carried out by the Central Ural Sovnarkhoz. The basic steps towards sanitation of the surrounding air included the construction of new and the updating of existing purification installations, improvement of their utilization, organization of research programs, and utilization of valuable products in industrial discharges. Atmospheric purification in industrial areas is conducted by construction of dust catchers and gas utilization shops; change in technological processes; establishment of protective belts of verdant plantings around industrial plants; and the closing of certain industrial plants. Many industries are changing from coal to oil, which is expected to greatly reduce ash, dust, and smoke emissions.

23674

Kluge, Wolfgang and Boeho Koeppe

EFFECT OF USING ELECTROSTATIC FILTERS ON DUST EMISSIONS FROM LIGNITE-FIRED POWER PLANTS. (Einfluss des Elektrofilterbetriebs auf die Staubemission aus Braunkohlenkraftwerken). Text in German. Energietechnik, 17(12):530-535, Dec. 1967. 4 refs.

A series of experiments were conducted with two two-stage horizonta electrostatic filters made by a firm in Leipzig. These were connected to the exhaust line of boiler furnaces using lignite for fuel. The coal had a 51.5% water and 12% ash content. Determinations were made of changes in the degree of separating effectiveness over a long period of operation, and differences between filter equipment that had been cleaned and filter equipment that was dirty. Comparisons were made between the two filters, the second of which was equipped with a longer plate (8.5 m instead of 3.3 m), with a more recent type of electrodes and discharge points, and with a selenium rectifier, so that this filter operated at 400 mA and 75 kV, as compared with 200 mA and 40 kV for the first filter. Measurements obtained with the older-type filter were compared (with good agreement) with test results of 10 years previous, on the same type of equipment. Comparative tests with the second filter were made immediately after installation and about 6 months later. Dust content of the purified gases were determined as a function of filter current intensity at several states of filter current, from maximum down to zero mA. Further testing consisted in varying the operation of the discharge mechanism. Very little difference was noted between the two filters from the standpoint of 'clean' and 'dirty' operation, but from the standpoint of heavy-duty operation, the new filter gave as high as 26% better performance, with an average improvement of 6%. In the current range of 300-400 mA, it was found by extrapolation that the use of the new type rectifier permits a significant decrease in the dust content of the purified exhaust, amounting to as much as one third of the total content. Elimination of a filtering stage had a significant effect on the filtering efficienc of the electrostatic stage. When an earlier stage was omitted, the dust content of the filtered air was 3 times as high; when a filtering stage following the electrostatic stage was omitted, the dust content was 4 times as high. The article also discusses the effects created by varying the discharge time, the influence on filtering efficiency of the manner in which the plant is operated, and procedures for monitoring the operation of an electrostatic filter, such as by the measurement and recording of electric curren intensity.

23846

Hopps, George L., A. A. Berk, and J. F. Barkley

TESTS OF ADDITIVES TO CONTROL SOOT DEPOSITION IN OIL-FIRED BOILERS. Bureau of Mines, Washington, D. C., Rept. of Investigations 5947, 19p., 1962. 15 refs.

The use of fuel additives to control soot deposition in oil-fired boilers was investigated. Various chemicals, including compounds of copper and lead, were added to a mixture of No. 2 and No. 6 fuel oils that was fired in an experimental furnace. Tests were made to determine the effectiveness of these chemicals in removing soot deposits on probes devised to simulate heat-transfer surfaces in boiler and the effectiveness of the chemicals in preventing the deposition of soot on the probe surface. Test conditions were regulated so that the temperature of the products of combustion adjacent to the probes was in the range of 625 to 700 F. The clean-metal temperatures of the air-cooled probes were comparable with the water-tube temperatures in boilers operated at 40 to 100 psig. The dosages of the fuel oil additives used in these tests were generally larger than those usually recommended for most proprietary compounds. The results of the investigation were not conclusive. Under the experimental conditions that were employed, reproducibility of test data was poor. Consequently, the data do not provide a basis for rating or comparing the effectiveness of th several additives used in this work. The only statement that can b made with any degree of certainty is that none of the additives prevented the formation of soot deposits on the probes. Deposition from flue gas at a temperature higher than 700 F was not investigated. (Author abstract modified)

24043

Stairmand, C. J. and R. M. Kelsey

THE ROLE OF THE CYCLONE IN REDUCING ATMOSPHERIC POLLUTION. Chem. Ind. (London), 1955:1324-1330, Oct. 15, 1955. 5 refs. (Presented at the Society of Chemical Industry, Prevention of Atmospheric and Water Pollution in the Chemical Industry Symposium, London, April 4-5, 1955.)

Some methods of predicting the performance of cyclone dust arrestor under various conditions, and hence assessing the value of the equipment for a given duty have been given. The suitable method for comparing the absolute performances of different collectors is in terms of the collection efficiency for each of various particle -size groups. In considering the probable effect of final discharg to the atmosphere, the mass emission of the various sizes of particles is of primary importance, as overall collection values may be misleading. Typical grade-efficiency curves are provided for the four groups of dust arrestor under consideration, and the performance of each of the four types of collector in removing the fly ash from a stoker-fired boiler is considered. The four main types of cyclone dust or grit arrestor include the simple dust collecting fan, the medium-efficiency or high-throughput cyclone, the high-efficiency cyclone, and the multicyclone. From a knowledge of the size grading of the particles emitted from a stack, it is possible to calculate the dust deposition rate in the neighborhood of the stack, taking account of the meteorological conditions in the ambient atmosphere. Projected area values are given for the inlet dust and for the exit dusts from the four schemes considered, to assess the probable improvement in the appearance of the plume after fitting dust arrestors. Use of high-efficiency cyclones in conjunction with electrostatic precipitators is mentioned, as well as the use of cyclones in a series. Small cyclones are suggested to be more efficient than the larger ones, but much of the theoretical advantage may be lost in service by partial plugging of the cyclone inlet and exit ducts.

24291

Kukin, Ira

ADVANCES IN THE USE OF CHEMICAL TREATMENT IN AIR POLLUTION REDUCTION PROGRAMS. Preprint, National Petroleum Refiners Association, Washington, D. C., 18p., 1968. 4 refs. (Presented at the National Petroleum Refiners Association Rocky Mountain Regional Meeting, Billings, Mont., Oct. 2-3, 1968, Paper RM-68- 80.)

Extensive in-plant tests were made on the ability of a fuel additive containing 25% activated manganese to keep boiler fireside tubes clean and to reduce the sulfur trioxide content of the flue gas. Especially good results were obtained in a pressurized furnace of 2500 psig when low sulfur fuel oil (one percent) was burned. After three months, the treated furnace showed a 75% reduction in the SO3 content of the flue gas and only slight tar deposits were apparent. The deposits could be brushed off rapidly, even by simple air lancing. Since the additive is a true 'in-flame' catalyst, it can be applied in much smaller quantities than is the case with magnesium oxide additives. The manganese additive is not stoichiometrically consumed in reactions with vanadium and sulfur oxides but regenerates itself. It reacts with carbons and hydrocarbons to increase the carbon dioxide content of the flue gas; it further lowers the ignition temperature of combustible deposits within a furnace. By eliminating soot, it improves the appearance of stacks. Another factor favoring the use of the additive is that it reduces the excess air to fuel ratio.

24480

Pennsylvania State Univ., University Park, Dept. of Fuel Technology

ADAPTATION OF THE EFM FIRE-JET STOKER FOR BITUMINOUS COAL. In: Report of Bituminous Research Activities. Serial No. 57. Proj. 392-B-7, p. 30-49, 1956. 2 refs.

Modifications to a stoker and boiler are described along with the tests to determine the effects of the modifications. The modifications include the installation of a water-cooled coal feed throat to reduce coking, installation of over-fire air jets for improved air diffusion and reduction of particulate emissions, addition of coal pushers to break up coke formed in the feed throat shortening of the grate to speed coal ignition, installation of a refractory arch, insulation of the boiler, and modification of the draft controls to reduce back-burning. The combination of changes made it possible to obtain 95% or better boiler ratings during eleven tests with ten coals. The highest boiler rating was 150%. Efficiencies of the eleven tests ranged from 65.2 to 73.4%. Refuse ash ranged from 63.5 to 82.1%. Fly-ash deposited in the dust collector ranged from zero to 0.23 pounds per 100 pounds of coal. Carbon dioxide content of the flue gas varied from 6.1 to 12.9%. A series of cyclic tests was run to obtain efficiencies under various typical operating modes. These data are presented tabularly. An attempt to correlate two common coal performance tests, free swelling index and specific volatile index, provided scattered data points and no definite relationship. The burning rate of most coals tested was doubled by the stoker modifications. The percent boiler rating was increased by more than 100% in most cases. The efficiencies obtained were better than those of small, single-retort stoker fired boilers of the same size-class. The refractory arch appeared to be the most important modification. It improved ignition, combustion, and efficiency and substantially increased the burning rate. Also, it costs less, lasts longer, and gives better results than a stainless steel arch. Overfire air jets were effective in reducing smoke. The useful function of the coal pushers is limited to the first few minutes of each 'on' period. The length of the grate is important insofar as time for complete combustion is involved, but specific dimensions are not ye established. The value of the water-cooled coal feed throat is questionable.

24536

Shiosawa, Kiyoshige

DIAGNOSING AIR POLLUTION IN TAIWAN. (Taiwan no taiki osen o shindan shite). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 4(2):51-55, Feb. 1968.

Air pollution in Taiwan as observed in 1967 is described. It differs in essence from that of Japan, the United States, or Europe. Most of the air pollution in Taiwan can be controlled by thoroughly accomplishing technical maintenance. Most of the black smoke is caused by inferior combustion maintenance. Boilers and furnaces are not well equipped with meters, and operations are done by experience alone. Maintenance of fuel is not complete. Design of stacks is not good, i.e., they are short and thin. Many facilities are obsolete. There is a lack of technically capable personnel. Thus it is evident that the problem in Taiwan is not as complex as in Japan, and most of the problems can be solved by improving combustion maintenance.

24613

Bernhoff, R.

EXPERIENCES WITH THE USE OF LIME IN FLUE GAS DESULFURIZATION. AB Cementa, Malmoe, Sweden, 39p., 1970. 43 refs.

Several limestone addition methods of controlling sulfur dioxide ar discussed. There are two types of such processes- wet and dry. In the wet process a slurry of lime is introduced directly into a scrubber The SO2 reacts to form calcium sulfite or sulfate. In the dry process, pulverized limestone is blown directly into the boiler, where it reacts to form calcium or magnesium sulfite or sulfate. The dry process is only about 50% efficient, so it is used primarily with low sulfur fuels. The general term limestone covers a range of compounds containing calcium and magnesium. Most tests show that dolomitic limestone is not as effective as hig calcium limestone. The sorption rates of various limestones vary, depending on particle size, precalcination, temperature, point of injection, and stoichiometry. Several operating power plants which have limestone control processes are described, including two plants in the U. S. and one in Sweden. Cost studies of the operations are given, including the cost of solid waste disposal and potential recovery methods.

24642

Knapp, Otto and Hans Luettger

DESIGN CHARACTERISTICS AND TEST RESULTS OF A NEW MULTICELL FILTER. (Konstruktionsmerkmale und Versuchsergebnisse eines neuentwickelten Vielzellenfilters). Text in German. Wasser Luft Betrieb, 14(9):358-360, Sept. 1970.

In order to stay within limits of the maximum permissible dust emission in the case of a Vekos-Powermaster boiler, a dust extractor was developed characterized by a filter housing with a comparatively large number of cells in the filter housing and by a strictly tangetial direction of the raw gas flow with relatively small velocity (9.5 m/sec). The cells are small diameter cyclones with the flue dust being returned to the furnace. The combustion air purified by this filtering arrangement contained dust levels of between 140 and 236 mg/ N cu m when bituminous coal was used as fuel. The construction has unusually low resistance because of the unhindered inflow of the gas into the cyclones and because of the low gas velocity. The arrangement was tested on a boiler with a mechanical firing mechanism of 80% efficiency, fired with bituminous coal nut size 3 and 4, an ash content of 3.7%, and a 3.1% H2O content. The raw gas dust content was 0.882 g/ cu m; the purified dust gas content, 0.074 g/ cu m; and the efficiency of the cyclone dust arrester battery, 91.65%.

24645

Muraki, Ryoji

A NOVEL PROCESS FOR NEUTRALIZING AN ALKALINE WASTE WATER AND FOR DESULFURIZING SMOKE. (Arukari haisui no chuwa to haien datsuryu no atarashi hoho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(10):825-827, Oct. 15, 1970.

A bubble-contact absorber was developed for simultaneously desulfurizing boiler smoke and neutralizing alkaline waste water. The boiler described uses heavy oil and generates 7.48% carbon dioxide and 0.2% sulfur dioxide. The waste water of the dyeing factory contains large amounts of caustic soda that can be neutralized by sulfur dioxide. The alkaline waste water is neutralized to a pH of 9 by the first step of the reaction and to a pH of 4.7 by the second. However, the standard for waste water is pH 5.6-8.6 so the reaction of the second step must be advanced. Application of the process is difficult because the quantities of sulfur dioxide and waste water are not constant. If the amount of alkalies greatly exceeds the sulfur dioxide, carbon monoxide is added to the gas. Addition of a strong acid like sulfuric acid to the water for the pH Control is not effective, since, for example, the sulfate radical is consumed by the substitution of salts by sulfur dioxide. In the absorber, bubbles of carbon dioxide contact the alkalies: the water is neutralized to a pH of 9 by the carbon dioxide and to a pH of 6.8 by the production of carbonic acid. The pH value then remains a constant 6.8, since the carbon dioxide does not react at this degree of acidity. The apparatus effectively utilizes the surplus sulfur dioxide gas, in which case caustic soda is usually added. The relationship between the amount of smoke and that of alkali to be neutralized is shown in a diagram. The bubbles formed in the apparatus is very fine and present in large quantities.

24675

Henke, William G.

THE NEW 'HOT' ELECTROSTATIC PRECIPITATOR. Combustion, 42(4): 50-53, Oct. 1970.

The problems associated with low-sulfur fuel are causing increased interest in the 'hot' electrostatic precipitator which, among its features, includes insensitivity to the sulfur content of the gases it cleans. By being located ahead of rather than downstream of the air heaters, the fly ash hot precipitator operates in the range of 500 to 700 F. However, the volume of gas at 600 F is nearly 40% greater than that of the same weight of gas at 300 F, and the higher cost of the hot precipitator is principally a matter of size. Low sulfur problems are caused by the fact that good electrostatic precipitator performance can only be obtained within a relatively narrow range of fly ash resistivity, roughly from 10 to the 8th power to 10 to the 10th power ohm-cm. Further details are considered of low sulfur problems, as well as problem solutions. One approach is enhancement of surface conductivity, but the more attractive alternative is to end dependence on surface conductivity with a high operating temperature. Oil ash is much more of a mobility problem whan fly ash, but at the temperature at which it leaves this hot precipitator, no problems have been encountered in hoppers or the conveying system. Six hot precipitator installations already operating on a pulverized coal boiler fly ash cover a variety of differing applications.

24678

Bartok, W., A. R. Crawford, and A. Skopp

CONTROL OF NITROGEN OXIDE EMISSIONS FROM STATIONARY COMBUSTION SOURCES. Combustion, 42(4):37-40, Oct. 1970. (Presented at the AICHE-IMIQ Joint Meeting, 3rd, Denver, Colo., Aug. 30-Sept. 2, 1970.)

Cost-effectiveness analyses of potential oxides of nitrogen control methods are presented for stationary combustion sources, and research and development needs in this area are critically evaluated. National Air Pollution Control Administration sponsered research related to stationary NOx control is discussed, including modeling of NO kinetics in combustion processes and the scrubbing of NOx from flue gases. The major factors known to influence the NOx emissions from combustion processes are the amount of excess air used for combustion, the heat release and removal rates, which define the temperature-time history of the combustion gases, transport effects, and fuel type and composition. Combustion flue gas treatment processes have been evaluated in the following general categories: catalytic decomposition of NOx, catalytic reduction of NOx, physical separation of NOx from the other components of the flue gas, adsorption of Nox by solids, and absorption of NOx by liquids. Aqueous absorption systems using alkaline solutions or sulfuric acid appear to offer the most promise for combined control of nitrogen and sulfur oxide emissions. In simple terms, cost effectiveness is defined as the ratio of the annual control cost to the tons of NOx removed. The estimated degree of NOx reduction and associated costs resulting from the application of potential control techniques are presented for a 1000 MW gas-fired, and a 1000 MW coal-fired power plant boiler. (Author abstract modified)

24821

Tamura, Zensuke

GAS PURIFICATION DEVICE. (Gasu seijo hoho). Text in Japanese. (Hitachi, Ltd., Tokyo (Japan)) Japan. Pat. Sho 45-16081. 2p., June 4, 1970. 2 refs. (Appl. Aug. 6, 1965, claims not given).

A control device designed to remove water soluble gases such as sulfur dioxide and sulfur trioxide contained in combustion exhaust gas discharged from a boiler or furnace is described. Numerous small sealed packs of cold water or small pieces of cooled material dropped into the exhaust gas first condense the water content in the gas and then adsorb the water soluble gases with the condensed water on their surfaces, thereby removing the water soluble gases from the exhaust gas. From this basic method is developed another in which the used packs or pieces of cooled material are neutralized, washed, dried, and fed into the gas purification tank again for continuous cycles of the purification process. An exhaust or waste gas purification device of this system designed for use with exhaust gas from a boiler consists mainly of a purification tower, a detachable alkaline solution tank provided under the tower, a washing/cooling tank, and a drier. Numerous sealed packs of cold water or pieces of cooled material are dropped into the tower full of the exhaust gas, where they condense the water content in the gas and adsorb SO2 and SO3 into the water so condensed on their surfaces as they fall down through the tower into the alkaline solution tank where they will be neutralized. They are then led into the washing/cooling tank in which they are washed and cooled with cool water. From there, they are lifted up into a dryer where they are dried and further elevated above the tower and put into the tower again for another cycle of the purification process.

25079

Humbert, Clyde O.

METHOD FOR ELECTROSTATIC PRECIPITATION OF DUST PARTICLES. (Koppers Co., Inc., Monroeville, Pa.) U. S. Pat. 3,523,407. 4p., Aug. 11, 1970. 8 refs. (Appl. March 29, 1968, 6 claims).

Electrostatic removal of particles that are entrained in a gas stream can be improved by the addition of preselected amounts of ammonia and water into the particle-laden gas stream where the gas is at an elevated temperature. Optimum precipitation occurs when ammonia is added in an amount of from 10 to 20 ppm of gas, if water is added in an amount of from 4-8 gallons per 100,000 cu ft of gas, and the gas temeprature is above 400 F. The ammonia and water added to the gas stream are believed to react with the sulfur trioxide to form an ammonium bisulfate film which envelops the particles. Ordinarily, fly-ash particles from a power plant, for example, include a minor amount of SO3. It appears that a synergistic relationship exists to explain the improved collection efficiency.

25468

Glowiak, Bohdan and Adam Gostomczyk

SULFUR DIOXIDE SORPTION ON ANION EXCHANGERS. Preprint, International Union of Air Pollution Prevention Associations, 19p., 1970. 10 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-23E.)

The experiment of using anion-renewable exchangers in sulfur dioxid sorption from gases was conducted in three stages. An artificially created mixture of sulfur dioxide and air was passed through a column 50 mm in diameter in the first stage. The column was filled with an anion layer 300 mm high. Next, a laboratory device was use for obtaining SO2 from the exhaust gases which were emitted by a boiler-house. The gases had to be dedusted and cooled before passing through the column with anion. At the third stage, a pilot apparatus was installed in a sulfuric acid works, and the characteristic features of an installation working at this stage are described. The method which was utilized consisted of forcing gases with countercurrents through a layer of anion exchanger resin which was sprayed with hydroxide solution. This method can be used for purification of gases which have a temperature lower than 60 C and which do not contain dust. Efficiency increases slightly, simultaneous with the increasing concentration of spraying solution and with that of SO2 in the purified gas. (Author abstract modified)

25637

Sieth, Joachim and Hans-Gunter Heitmann

APPARATUS FOR CONTINUOUSLY MEASURING THE CONCENTRATION OF A GAS- MIXTURE COMPONENT. (Siemens-Schuckertwerke AG, Berlin (West Germany) U. S. Pat. 3,367,747. 5p., Feb. 6, 1968. 4 refs. (Appl. March 11, 1964, 10 claims).

In combustion plants, particularly steam-boiler plants, the flue gases contain more or less considerable quantities of sulfur dioxide as well as traces of sulfur trioxide, stemming from the combustion of sulfurous fuels such as coal and oil. When the temperature of the flue gases drops below the dew point, the gases condense and may cause serious damage by corrosion in the boiler. Since the dew point is influenced substantially by the proportion of sulfur trioxide in the waste gases, it is desirable to provide means for measuring the SO3 concentration in a gas mixture. Accordingly, the concentration of SO3 and SO2 in a flow of smoke gas can be measured by performing the following steps: treating the flowing gas mixture continuously with condensing water vapor to selectively absorb SO3 from the mixture; continuously measuring the concentration of the sulfuric acid solution resulting from the reaction of the condensing water and the SO3, this concentratio being indicative of the SO3 concentration in the gas mixture; continuously treating the residual flow of gas, now free of SO3, with water to absorb SO2; and measuring the concentration of the sulfurous acid solution resulting from the reaction of water and sulfur dioxide, as indicative of the SO2 concentration in the gas mixture. The concentration of the sulfuric acid solution and/or the sulfurous acid solution is advantageously determined by electric conductivity measurements.

25643

Sykes, W. and F. Broomhead

PROBLEMS OF ELECTRICAL PRECIPITATION REVIEWED. Gas World, 134(3494):98-104, Aug. 4, 1951. 5 refs.

Aspects of the design, construction, and operation of the electrical precipitator are discussed. The great advantage of this device is its ability to remove with high efficiency dust of particle size much smaller than that removable by mechanical or cyclone separators. Back pressure, and power needs to produce the corona discharge, a very small; however initial costs are much higher. Problems considered at length include removal efficiency and its relation to time contact of the gases in the field, design of the precipitation chamber, insulator breakdown. gas distribution across the precipitator, removal of deposits from electrodes, and electrical equipment requirements. Five essential design factors are given: correct time contact, good gas distribution throughout the fields, design and arrangement of the electrodes, maintenance of clean electrodes, and maintenance of correct voltage. Examples of the following typical application are described and the principal design features are indicated in each case to point up the great variety of constructions required by specific and differing operating conditions: detarring of producer gas from coal and coke, chamber and contact process sulfuric acid manufacture, aluminum and cement production, boiler flyash precipitation, gypsum dust removal, sodium sulfate recovery in the Kraft pulp industry, cleaning of blast furnace gas, air conditioning, and spray painting.

25786

Busby, H. G. Trevor and K. Darby

EFFICIENCY OF ELECTROSTATIC PRECIPITATORS AS AFFECTED BY THE PROPERTIES AND COMBUSTION OF COAL. J. Inst. Fuel (London), vol. 184-197, May 1963. 4 refs.

The results of an investigation into the adverse performance of electrostatic precipitators on pulverized-fuel boilers firing certain coals from England and Australia are discussed. The effect of the electrical resistivity of the fly-ash is examined; when the resistivity of the dust exceeds about 10 to the 13th power ohm/cm, the efficiency of precipitation is reduced. The resistivity of the dust is determined by the surface condition of the dust particles. The adverse effect when resistivity is high ca be overcome by the injection of sulfur trioxide into the flue before the precipitator: this is completely absorbed by the dust. The formation of sulfur trioxide from combustion of the sulfur in the coal is an over-riding factor in determining precipitator efficiency and this, while broadly related to sulfur content of coal, is also affected by unknown factors in the combustion process. (Author abstract modified)

26104

Tamura, Z.

COMBUSTION EMISSION GAS DISPOSAL METHOD. (Nensho haigasu shorihoho). Text in Japanese. (Hitachi, Ltd., Tokyo (Japan)) Japan. Pat. Sho 45-22925. 4p., Aug. 3, 1970. (Appl. Aug. 6, 1965, claims not given).

A process is described that permits the continuous and efficient desulfurization of gases emitted from boilers and furnaces. Exhaust gas is led to a high-temperature air pre-heater and then to a dust collector where carbonic grains or dust are removed. Next, the gas is passed to an adsorption-separation unit comprising three chambers: a high-temperature adsorption chamber, a low- temperature adsorption chamber, and a high-temperature separation chamber. All three chambers are filled with activated charcoal or semi-coke for the adsorption of sulfur dioxide or hydrogen sulfide. After the two-stage adsorption process, the desulfurized gas goes to a low-temperature heat exchanger from which it is discharged to the atmosphere. Heated inert gas (such as nitrogen) is introduced into the separation chamber to effect the separation of the adsorbed sulfurous or sulfuric acid gas from the adsorbent. The gas so separated is led to a deoxidation device for further processing.

26312

Rak, M. V.

USE OF SIGNALS CONVEYING INFORMATION REGARDING THE OPTICAL DENSITY OF FLUE GASES FOR AUTOMATIC CORRECTION OF THE AIR SUPPLY OF FUEL-OIL-FIRED BOILERS. (Ispol'zovaniye signala po opticheskoy plotnosti dymovykh gazov dlya avtomaticheskoy korrektsii vozdushnogo rezhima mazutnykh kotlov). Text in Russian. Elektr. St. (Moscow), 41(10):27-29, Oct. 1970. 2 refs.

The problem of regulating excess air ratio so as to maintain an efficient balance between corrosion in the exhaust sections and losses due to incomplete combustion is analyzed, and a control function capable of maintaining an optimum air supply to within plus or minus 0.24% O2 is derived. Feedback for this control function is provided by monitoring the optical density of the flue gas.

26365

Snopek, S.

CONTROL OF COMBUSTION PROCESSES AND EMISSIONS FROM INDUSTRIAL COMBUSTION CHAMBERS. (Rizeni-spalovacich procesu a emise z prumyslovych topenist). Text in Czech. Ochrana Ovzdusi, vol. 11-12:161-166, 1969.

Some aspects of combustion processes are considered in relation to emissions occurrence. The control of the combustion process by analysis of flue gases guarantees effective use of fuel and at the same time most effectively limits the occurrence of bothersome gaseous emissions. To effectively limit and control the amount and occurrence of toxic components of flue gases such as carbon monoxide, sulfur dioxide, sulfur trioxide, and some hydrocarbons, reliable analytical data on composition of flue gases must be obtained. An automatic analyses, Aspex, suitable for this task is described, which enables simultaneous determination of both combustible components of flue gases and oxygen. From the latter, SO3 occurrence can be estimated and SO2 concentration determined, provided original S concentration in the fuel is known. The possibility of limitation or elimination of CO, hydrogen, methane, and more complex organic radical occurrence is flue gases by suitable control of the combustion process is discussed. The facts discussed are supported by practical measurements accomplished with the use of Aspex.

26369

Ulke, R. and K. Schaefer

THE HEATING PLANT AND LONG-DISTANCE HEAT SUPPLY NETOWRKS OF THE MUENSTER UNIVERSITY. (Heizkraftwerk und Fernwaermenetze der Universitaet Muenster). Text in German. Tech. Mitt. Krupp., 27(1):39-46, 1969. CFSTI: N70-12682

The plans for the construction of a heating plant and a long-distance supply network of steam and hot water for the University of Muenster covering an area of 88 ha elaborated by the Friedrich Krupp Works designed to supplant an outmoded heating plant are outlined. The plant is planned for a heat output of 110 G cal/h, a furnace output of 150 t.h. and an electric output of 5 MW. A thermal power plant is included in the plant designed to supply electricity for the University's Medical School. The boiler house, the power station, and the thermal control switching station are described. The dust filters for the boiler furnace are so designed as to keep the emission level below 150 mg N per cu m. The stack height of 70 m and firing of anthracite with a maximal sulfur content of 1% are designed to keep SO2 concentration in the close vicinity of the thermal power station at a maximal level of 0.3 mg/cu m. To meet the requirement of maximal noise pollution of 60 DIN-Phon at a distance of 10 m from the power station, appropriate insulating materials are provided for. The construction of overhead supply pipelines, transfer stations and of the long-distance heat supply network are described.

26378

Ochs, Hans-Joachim

IMPORTANCE OF DUST REMOVAL FROM FLUE GAS. (Belange der Rauchgas-Entstaubung). Text in German. Maschinenmarkt, 74 (8):123-126, 1968. 3 refs.

Flue-gas dust removal in boiler plants is discussed in relationship to recent West German legislation. The properties of flue gases are presented in the form of mathematical formulas for use in planning the installation of dust removal equipment. Special attention is given to the properties of electrostatic filters as the predominant type of equipment now being used. The injection of a small amount of sulfur trioxide as a mist reduces the electrical resistance of the dust. This reacts with the moisture content of the fumes to form a sulfuric acid precipitate, and the lowering of the moisture content thereby enhances the electrostatic effect of the filter. A table is given of the sulfur content of various types of coal. The economic aspects of the use of various types of dust-removal equipment are discussed. An especially critical problem is presented by boilers that use coal dust as fuel, since the fly ash can contain more than 20% of crude dust, necessitating the additional use of a cylcone as prefilter for the electrostatic equipment.

26451

Hall, R. E., J. H. Wasser, and E. E. Berkau

NAPCA COMBUSTION RESEARCH PROGRAMS TO CONTROL POLLUTANT EMISSIONS FROM DOMESTIC AND COMMERCIAL HEATING SYSTEMS. Preprint, National Oil Fuel Inst., New York, 18p., 1970. (Presented at the National Oil Fuel Institute, New and Improved Oil Burner Equipment Workshop, 3rd, Hartford, Conn., Sept. 23-24, 1970.

A description is presented of research, within the Air Pollution Control Office (formerly NAPCA), directed toward controlling air pollution from stationary fossil-fuel boilers through combustion modification. The research is primarily concerned with control of nitrogen dioxides and combustible particulates emitted from domestic and commercial heaters burning distillate and residual oil. Domestic heater studies will evaluate the performance of heater components, attempt to correlate burner dimensions with flame characteristics and pollutant emissions, and investigate the control of cyclic-based emissions. Commercial heater studies will also relate burner-boiler design with flame characteristics and pollutant emissions. In addition, a model combustion chamber will be used to determine the effects of the following variables: air-fuel ratio, combustion intensity, fuel temperature, residence time, and fuel composition. The model chamber studies will provide a basis for a model commercial heating combustor capable of multi-fuel mixing. Studies applicable to both domestic and commercial heating systems will involve the chemistry of pollutant formation during combustion and also the control techniques of external flue gas recirculation, staged combustion, and internal flue gas recirculation.

26501

Host, John R. and David P. Lowery

POTENTIALITIES FOR USING BARK TO GENERATE STEAM POWER IN WESTERN MONTANA. Forest Prod. J., 20(2):35-36, Feb. 1970. 1 ref. (Presented at the Forest Products Research Society, Annual Meeting, 23rd, San Francisco, Calif., July 8, 1969.)

Most of the bark, as well as associated residue, produced by sawmills and plywood plants in Montana is used as fuel to generate steam. With one or two exceptions, the steam generating plants have been Dutch ovens, which release large volumes of pollutants to the air. To meet new state air pollution standards, the timber industry is now considering the use of traveling grate or suspension-burning boilers. These permit bark to be burned with a high heat efficiency and little or no air pollution. Both offer the prospect of generating more steam than Dutch ovens and at costs that are highly competitive with natural gas.

26544

Matsumoto, Hiroyasu

ON THE TREATMENT OF ALKALINE WASTE WATER BY BOILER GAS. (Boira haigasu ni yoru arukari haisui no shori ni tsuite). Text in Japanese. Nenryo Oyobi Nensyo (Fuel and Combustion), 36(12): 1189-1196, Dec. 1969.

A new device was developed to treat industrial waste gas and waste water simultaneously. It is called TCA and consists of an absorption tower with two grids, one at the top and the other at th bottom, between which light plastic balls are loaded (not packed). By passing gas and liquid at high velocity through the device from the bottom, the balls are put into turbulent motion and gas-liquid contact is promoted. Even if the reaction produces solid materials the motion of the balls serves as self-cleaning, and no clogging occurs. The absorption tower is mainly used for sulfur dioxide absorption, and the neutralizing agent is usually alkali waste wate from silkette processing or tanning, carbide slurry, or red sludge produced in alumina manufacturing. Detailed descriptions of the TCA operation is given for silkette processing and leather tanning waste water treated with boiler gas.

26545

Matsumoto, Hiroyasu

TREATMENT OF BOILER WASTE GAS AND ALKALI WASTE WATER. (Boira haigasu no shori to arukari haieki no shori). Text in Japanese. Kogai (Hakua Shobo) (Pollution Control), 4(6):300-305, Nov. 1969.

A new device was developed to treat industrial waste gas and waste water simultaneously. It is called TCA, and it consists of an absorption tower with two grids, one at the top and the other at the bottom, between which light plastic balls are loaded. By passing gas and liquid at high velocity through the device from the bottom, the spheres are put into turbulent motion and gas-liquid contact is promoted. Even if the reaction produces solid materials the motion of the balls serves as self-cleaning, and no clogging occurs. The device is mainly used for sulfur dioxide absorption, and the alkali solution for neutralization is the waste water from leather tanning, for example. A detailed description of the TCA operation is given for leather tanning waste water treated with boiler gas.

26546

Inagaki, Koshiro

SMOKE AND DUST EMISSION STATUS IN AICHI PREFECTURE AND CONTROL FACILITIES. (Aichi kenka no baien hasseijokyo to boshi setsubi). Text in Japanese. Kogai (Hakua Shobo) (Pollution Control), 4(6):286-295, Nov. 1969. 9 refs.

Dust and smoke-producing industries in Aichi Prefecture include ceramic, textile, wood fiber board, heavy chemical, and metal industries; the emission sources include boilers, sintering, electric and blast furnaces, and open hearths. The emission data such as the type of furnace, fuel, emission quantity, and sulfur oxides concentrations are given for various industries such as ceramic, wood fiber board, and steel; some of the emission control facilities such as dust precipitators, gas purifiers, and dust precipitators for open hearths are described in detail.

26560

Ogata, Yoji

SMOKE DISCHARGE DEVICE. (Haien sochi). Text in Japanese. (Mitsubishi Heavy Industries, Ltd., Tokyo (Japan)) Japan. Pat. Sho 45-20065. 7p., July 8, 1970. (Appl. May 31, 1967, claims not given).

A smoke discharge device or stack is designed to permit easy detection of internal corrosion so that timely remedial action may be taken promptly for proper maintenance. Ring-shaped space formed between the outer tube and the inner tube of this chimney is divided into several air-tight chambers. An outlet cock is provided on the outer wall of each air-tight chamber which is usually closed with a plug. When a particular part of the inner tube is corroded, the gas or smoke going through the inner tube leaks through the corrosion hole into the pertinent air-tight chamber. This gas or smoke leakage can be easily detected from outside simply by opening the outlet cock and checking the leakage, so that the location of the corrosion of the inner tube may be found accurately and promptly. With inspection of this kind conducted regularly or whenever necessary, partial corrosion can be corrected before it grows to a major corrosion of the entire system Especially in view of the fact that an increasing number of boilers today use heavy oil fuel that usually contains more sulfur for economical reasons, their chimneys are more than ever exposed to sulfuric acid gas contained in the exhaust gas and therefore subject to an accelerated corrosion. This invention offers an easy and economical way for proper maintenance of chimney or smoke discharge equipment used with heavy oil-burning boilers.

26665

'ELECTRIC' CHIMNEY ATTRACTS SMOKE AND WASHES IT AWAY. Engineer (London), 231(5994):33, Dec. 10, 1970.

An electrostatic precipitator has been designed to operate in conjunction with industrial incinerators, boilers, dust extractors, and other similar equipment to limit smoke emission and pollution by harmful gases. The Aeropur features high-voltage operation with water irrigation, as well as low running costs. In operation, dust laden gases from the incinerator or boiler enter the Aeropur's tower base through an involute entry port and are directed by a fixed helix to a spiral path ascension. A central mast mounted on an insulator carried banks of electrodes with multipoints to allow corona discharge ionization of the dust particles. The resultant charged particles are attracted to the side plates where water irrigation washes them to the tower base and then into a settling tank. A water flow rate of 10 gal/min is all that is needed to irrigate the unit and this can be recirculated via a combined water reservoir and sludge tank.

26857

Haynes, W. P.

CURRENT WORK AT THE BUREAU OF MINES ON RECOVERY OF SULFUR OXIDES FROM STACK GAS. American Institute of Chemical Engineers, New Yo N. Y. and American Society of Mechanical Engineers, New York, Proc. MECAR Symp. New Developments in Air Pollution Control, New York, 1967, p. 50-61. 10 refs. (Oct. 23.)

In a program designed to develop methods for removing sulfur oxides from stack gases, the Bureau of Mines has been investigating the absorption activities of manganese oxides and alkalized alumina, solid absorbents for elevated temperature absorption, Teller chromatographic absorption processes, and dolomite injection into boiler furnaces. A summary is presented of the activity of the absorbents tested to date. Experimental data are also given for small pilot-plant studies of the dolomite injection process and a large alkalized alumina pilot plant study. Initial experiments show that admixing of fine dolomite in powdered coal is effective in reducing sulfur oxides in stack gases, though excessive amounts of dolomite are needed to achieve satisfactorily low concentrations In initial tests at the alkalized alumina pilot plant, up to 85% of the SO2 in flue gas has been removed. Prospects of attaining 90% removal are reasonably good.

27243

HOLDS 'THERMAL' CHIMNEY A POLLUTION SOLUTION. Natl. Eng., 74(12):6-7, Dec. 1970.

The purpose of the chimney cap is to create a condition within the stack that maintains and preserves a constant exhaust temperature from the breeching inlet to the top of the stack. When this temperature control is reached, natural buoyancy will pull the combustion gases out the top of the stack as fast as they enter the stack, thereby allowing an even flow of combustion air to support an even, constant combustion reaction. Improperly designed and/or sized chimneys allow an influx of colder air from above. Temperature differentials between the upward flow of hot stack gases and colder air flowing downward in the excess space of the stack causes excess condensate to form, which then flows down stack walls until heated sufficiently to become steam, at which time it then rises until sufficiently cooled to condense to water vapor. This recycling process of steam and vapor demands more pressure to exhaust combustion gases through the boiler into the stack because of overpressure in the combustion chamber. The chimney cap prevents entry and flow of the colder air of the atmosphere down into this space. Ideally, the opening in a chimney cap approximates the cylindrical column of hot stack gases rising up the chimney.

27295

Bartok, W., A. R. Crawford, and A Skopp

NITROGEN OXIDE POLLUTION: CONTROL OF NOX EMISSIONS FROM STATIONARY SOURCES. Chem. Eng. Progr., 67(2):64-72, Feb. 1971. 35 refs.

Potential combustion control techniques for reducing nitrogen oxides emissions from stationary sources consist of modifying equipment and design features which affect such combustion parameters as excess air level, heat release and removal rates, and distribution of fuel and air. The evaluation of a kinetic model of nitrogen oxide formation has shown that the most important operating modifications are low excess air-firing, two- stage combustion, flue gas recirculation, water injection, and combinations of these techniques. The important design features are burner configuration, locating and spacing, and the types of firing and combustion methods used. Removal of nitrogen oxides from flue gases provides a potential alternate method for controlling combustion-related emissions. Flue gas treatment processes potentially capable of controlling sulfur oxides emissions as well as nitrogen oxides are catalytic combustion; catalytic reduction; adsorption/reaction by solids; absorption/ reaction by liquids; and physical separation. The estimated degree of nitrogen oxides reduction and associated costs resulting from the application of potential control techniques are presented for a 1000 MW gas-fired and 1000 MW coal-fired power plant boiler.

27658

Koerner, H. J.

DUST FALL MEASUREMENTS IN THE KASSEL AREA. (Staubniederschlagsmessungen im Gebiet von Kassel). Text in German Gesundh.-Ing., 91(12):351-353, 1970. 2 refs.

The maximal permissible yearly median concentrations for non toxic dust are 0.42 and 0.85 g/sq m/day for non industrial and industrial areas respectively. Respective maximal permissible peak concentrations (monthly median averages) are 0.65 and 1.3 g/sq m/day. In 1968, dust precipitation measurements were performed in 66 individual sectors within the city limits of Kassel by means of the Bergerhoff device and compared with previously recorded levels. In 47 sectors concentrations of up to 0.21, in the 19 remaining sectors concentrations up to 0.42 g/sq m were established. Thus dustfall in all sectors was within prescribed limits. The reduction of dust concentrations in the industrial suburb of Bettenhausen is attributed to the conversion of a number of large boiler furnaces from bituminous coal to oil.

28113

Stookey, Kenneth W.

FURNACE EMISSION CONTROL SYSTEM. (Torrax Systems, Inc., North Tonawanda, N. Y.) U. S. Pat. 3,557,725. 5p., Jan. 26, 1971. 3 refs. (Appl. July 10, 1969, 15 claims).

A furnace emission control system is described, which pertains to a vertical furnace charged at the top and having a heated well at the bottom in which hot gases are drawn off and supplied to an igniter for secondary combustion. The gases discharged from the igniter are passed through a waste heat boiler, then through an induced draft fan, and through a bag filter, or precipitator to the atmosphere. Gas flow throughout the system is maintained so that the furnace above the gas outlet is at subatmospheric temperature, with the gas flowing into the igniter. The oxygen content of the gases discharged from the waste heat boiler is determined, and secondary air is admitted to the igniter if needed. The temperatur of the gases from the igniter is measured, and supplementary fuel may be supplied to maintain the minimum safe operating temperature. Controls are provided to bypass gases above a predetermined temperature away from the bag filter and to maintain the igniter temperature above a predetermined minimum. (Author abstract)

28230

Dransfield, F. and H. J. Lowe

ELECTROSTATIC PRECIPITATORS FOR LARGE BOILERS--INCLUDING COMBINATIONS WITH CYCLONES. In: Gas Purification Processes. G. Nonhebel (ed.), London, George Newnes Ltd., 1964, Chapt. 13, Part B, p. 536-549.

A considerable quantity of fly ash is carried out of a boiler furnace in the flue gases when pulverized coal is burned. The carry-forward varies considerably with the type of firing; typical figures are 15-20% for cyclone furnaces, 45-55% for slag tap furnaces, and 80-85% for modern, fully water-cooled, dry-bottom furnaces. Dust burdens of about 10 grains/cu ft ntp are usual from the latter type of furnaces. The principal means of removing the fly ash is the electrostatic precipitator of which the two main types are tubular and plate. A good feature of tubular precipitators is that the gas cannot bypass the treatment zone; on the other hand, it is difficult to obtain uniform gas distribution among the tubes, and reentrainment of precipitated dust tends to be high. Plate precipitators are generally more compact, a feature useful in very large installations. Precipitators are commonly used for efficiencies up to 98.5%. For efficiencies of over 99%, a combination of a mechanical collector (usually an arrangement of cylones) preceding the precipitator is preferred. Factors influencing the performance of precipitators and mechanical collectors are discussed.

28271

Francis, W.

FLUE GAS-WASHING PROCESSES. PART FOUR. Power Works Eng., vol. 41:103-105, April 1946. 5 refs. Part I. Ibid., vol. 41:17-21 25, Jan. 1946. Part II. Ibid., vol. 41:37-40, Feb. 1946. Part III Ibid., vol. 41:75-77, March 1946.

The recovery of by-products from gas washing plants by using lime as the alkali appears to be practicable. Cement and sulfuric acid are produced in one method. The second process, the decomposition of the washer solids by ammonium carbonate, to produce ammonium sulfate and calcium carbonate, appears to be feasible if complete oxidation of sulfite to sulfate can be achieved. An alternative is to scrub with a sodium sulfite-bisulfite solution, and to precipitate the fixed SO2 by the addition of zinc oxide. The zinc sulfite thus formed may be decomposed at low temperatures to give concentrated SO2 and zinc oxide, which is used again. Solutions of ammonia or ammonium carbonate may be used as the scrubbing medium, producing ammonium sulfate and sulfur. The capital and running costs for this system probably will be lower than those for any other system of gas washing with recovery of by-products. (Author summary modified)

28503

Peew, Dimo and B. Hadschow

SULFURIC ACID CORROSION IN STEAM BOILERS THROUGH THE USE OF SULFUR-CONTAINING HEAVY OILS. (Schwefelsaeurekorrosion in Dampfkesseln bei Verfeuerung von Schwefelhaltigen Schweroelen). Text in German. Energietechnik, 21(1):30-33, Jan. 1971. (Presented at the Waermetechnischen Kolloquiums der Technischen Hochschule Otto von Guericke, 4th, Magdeburg, East Germany, July 1970.)

Studies of sulfur trioxide formation in flue gases, dew-point temperature, and corrosion speed in relation to boiler load and surplus air were carried out on four boilers operated at normal load, nominal load, and partial load. For flue gas analysis, a measuring point ahead of the air preheater was selected. Sulfur trioxide formation increased with increasing fuel-to-air ratio. The SO3 content in the flue gas rose from 0.00094% by volume at lambda 1.23 to 0.00204% by volume at lambda 1.56. Conversion of SO2 to SO3 was decisively influenced by the presence of atomic oxygen which develops through dissociation of the flue gases at the high temperatures found in oil-fired combustion chambers. A proportional dependence exists between SO3 concentration in the flue gas, dew point temperature, and corrosion speed. Injection of earth alkaline additives with a high fraction of magnesium oxide and calcium oxide reduce the SO3 concentration in the flue gases considerably. Powdery additives with more than 80% MgO and grain sizes of less than 80 mesh are very suitable for reducing the dew point temperature and sulfuric acid corrosion.

28517

STACK AND BOILER CONNECTION. (Schornstein und Kesselanschluss). Text in German. Oel Gasfeuerung, 16(3):332-340, March 1971.

There are two approaches to conduction waste gases to the atmosphere. (1) If the gases have a temperature higher than that of ambient air, they will be lighter than air and rise upward by their own force. The buoyancy of the gases depends on the stack height and the density difference between the cold air and the flue gases. (2) The gases are blown out of the furnace with the aid of a blower. The stacks must be higher than the roof to guarantee sufficient dilution of the waste gases. Oil-fired furnaces require stacks with smaller cross sections than coke-fired furnaces. This is frequently overlooked by plants switching from coke to oil, and as a consequence, the flue gases are overcooled and thus corrosive. Soot formation, too, can be favored by an overly large stack cross section.

28742

Oiwa, Tatsukazu

METHOD OF EXTRICATION SULFUR FROM EXHAUST SMOKE BY AMMONIA. (Anmonia gasu ni yoru haien datsuryuho). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):173, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

The KD Smoke Desulfurization System installed in the 26-story Kobe Commercial Trading Center building in November 1969 is claimed to remove 99.5% of the sulfur in boiler combustion gas. Waste gas leaving the boiler at 270-320 C is sprayed with ammonia gas and water to produce (NH4)2SO3 or (NH4)2SO4. The gas is then cleaned in a spiraely rotating scrubbing chamber to remove sulfur oxides, ashes, and other water soluble matter by adsorption. The spiral rotation chamber is characterized by the fact that isobaric centrifugal force during rotation creates a thin liquid film on the surface of the filter and removes the impurities in the waste gas. Studies are currently in progress on the reclamation of the sulfur oxides as ammonium sulfate or even as mirabilite.

28749

Nagami, K., K. Minemura, I. Shoji, Y. Noguchi, S. Nishimura, K. Mashimo, and K. Baba

METHODS OF PURIFICATION FOR OIL-BURNING BOILER. (Juyudaki danboyo boira haien no datsuryu sochi no tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):174, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

A new, simple waste gas desulfurization devide was developed for exclusive use on heating boilers. The method used is the wet type; since the water supply is quite limited for heating boilers, an alkaline solution is substituted for water. The device consists of a drum rotating around the horizontal axis, waste gas to be treated entering the drum in a tangential direction. The nozzle in the device sprays the alkaline solution. The heavy oil used for combustion was B-heavy oil with 1.77% sulfur content. The rpm of the rotating drum and the size of the nozzle aperture are not related to the sulfur dioxide removal efficiency of the device. When the flow rate of the waste gas increased, the removal rate declined, and therefore, the amount of solution had to be controlled to match the amount of gas passing through. Recycling of the treatment solution was very effective, and over a period of about 9 hrs more than 95% of sulfur dioxide was removed from the waste gas.

29013

Pinheiro, George

PRECIPITATORS FOR OIL-FIRED BOILERS. Power Eng., 75(4):52-54, Apri 1971.

The moderate plume visibility of oil-fired boilers, which the publi ignored in the past, is now considered unacceptable. In addition, there is the problem of acidic smut from oil firing. Experience with operating electrostatic precipitator installations has shown that smut can be eliminated and emission opacity substantially reduced. The stickiness of oil ash and its low resistivity make high precipitator efficiency more difficult to achieve. Nonetheles modification of flyash precipitators for oil ash is neither extensive nor extremely costly; the major change is a new power supply, or addition to the existing power supply. Other differences are minor: additional protection of high-voltage bushings, and special provision for ash removal from the precipitator. With these modifications, particulate emissions should be under 0.01 grains/standard cu ft.

29014

Papamarcos, John

FUEL OIL ADDITIVE PASSES TESTS. Power Eng., 75(4):46-48, April 1971. 1 ref.

Extensive tests of a new fuel oil additive were carried out on a 115,000-lb/hr boiler. The additive was a patented nitrogenous manganese complex called Rolfite 101. The sulfur trioxide level in the test boiler was about 25 ppm before fuel treatment. After 96 days of treatment, SO3 was eliminated and was virtually undetectable for the remainder of the year-long test. The additive also reduced deposit formation, cold-end corrosion of air heater tubes, smoke density (58%), and enabled the boiler to operate at lower excess air levels. In addition, all measurements made after treatment showed lower SO2 concentrations than the theoretical (e.g., 90% after 96 days and 78% after 314 days).

C 2

29231

Nakai, Yoshiyuki and Tetsuya Yokokawa

ACTUAL EXAMPLES OF KANAGAWA RESEARCH INDUSTRIAL INSTITUTE TYPE DESULFURIZING UNIT FOR WASTE GAS. (Shin ko shi shiki haien daturyu sochi no gutaiteki jitshi rei). Text in Japanese. Kagaku Kogaku (Chem. Eng.), 35(1):36-42, Jan. 1971.

Practical Kanagawa Research Institute type desulfurizing units for waste gas classify roughly into nonrecovering and recovering gas absorbing units. The nonrecovering type uses fresh or sea water as the absorbing solution for sulfur dioxide. The absorbing solution is released in a harmless condition without recovering the SO2. The recovering type effectively uses absorbed SO2 without causing a public nuisance. The gas and absorbent contact, but the liquid's surface tension causes them to form a thin surface on the wire mesh. Gas sucked into the unit cannot pass through without contacting the liquid plane. Also, the gas-liquid rate can be arbitrarily decided. If a greater rate of gas to liquid is needed, the quantity of flowing liquid is increased. Pressure loss at the contact surface is not related to the change of the liquid-gas rate. An actual example is the use of desulfurizing with hydrogen in the final gas treating unit in petroleum refining. When hydrogen sulfide produced by hydrogen desulfurization enters the combustion furnace for waste gas and becomes sulfurous anhydride, the desulfurizing unit is needed for high concentrations. Another application is the treating unit for waste gas from sintering furnaces in iron foundries. This gas is of fairly high concentration. Further, the gas includes many powder dusts but the KRI-wet-type has a good ability to manage for the structure without kinetic parts. Also, the waste gas treatment unit from the boiler in paper mills makes a caustic soda solution absorb sulfurous anhydride in waste gas. The produced sodium sulfate is used as a medicine for a pulp steam bath.

29441

Snyder, James D. and Robert F. Hickox

DOWNWIND, AKRON STINKS' -- II. Rubber World, 161(4):73-75, Jan. 1970.

The U. S. rubber industry is now thinking about ecology, since 142 million tons of toxic matter is being emitted into the air each year, health costs run as high as $4 billion each year, and chronic respiratory disease is a result of air pollution. The rubber industry generates at least 1.6 million tons of solid waste a year including discarded tires and spends only 1.6% of its capital on pollution control. Gas-fired boilers, electrostatic precipitators, dust collectors, and smokeless tips on flare stacks are being installed to eliminate smoke and fly ash. Also, new applications are being developed for reclaimed rubber; attempts are being made to recycle more waste back into the production process; and chemical compounds are being extracted from used tires for re-use. Akron's new pilot latex plant is a sophisticated latex waste treatment unit

29471

Anson, D., W. H. N. Clarke, A. T. S. Cunningham, and P. Todd

CARBON MONOXIDE AS A COMBUSTION CONTROL PARAMETER. J. Inst. Fuel (London), 44(363):191-195, April 1971. 13 refs.

Factors contributing to the controllable heat losses in boiler furnaces are considered in relation to the operating conditions, particularly excess air. The optimum condition is shown to be closely associated with the point at which any further reduction in excess air leads to a rapid rise in the heat loss due to incomplete combustion. Parameters for characterizing this point are discussed, and the flue gas carbon monoxide level is proposed. Results of performance checks on oil-fired boilers are presented to illustrate that for a particular plant monitoring of this parameter consistently indicates the standard of combustion performance, and hence that it can be used for control purposes. (Author abstract)

29514

Brinke, R.

VENTILATION AND EXPLOSION EXPERIMENTS IN A WATER-TUBE BOILER OF A POWER PLANT. (Durchlueftungs-und Verpuffungsversuche an einem Kraftwerks-Wasserrohrkessel). Text in German. Mitt. Ver. Grosskesselbesitzer, 51(2):104-111, April 1971.

For ventilation and explosion experiments, an additional gas burner was installed on a water-tube boiler fired with pulverized coal. A separate blower was assigned to the burner. The boiler was designed for 84 atm gauge, 500 C, and 64/80 tons/hr. During the ventilation experiments, the plant was operated in a pressureless state (all ventilation pipes open) with the oil burners. Changes in the carbon dioxide fraction in the waste gas were measured with an infrared analyzer. The experiments were conducted at air volumes of 60,000 to 17,000 cu m/hr. Application of high air volumes showed some success after a short period of time. The change in the CO2 fraction in the waste gas, which depends on duration of ventilation and on air volume, is illustrated. Ventilating with an air volume of 60,000 cu m/hr (90% of the capacity), the CO2 concentration at the boiler end was reduced to 50% in 102 sec (measured value) or 98 sec (calculated value), and to 0% in 240 sec (measured value) or 221 sec (calculated value). The frequency of air exchange for total removal of CO2 at the boiler end was 7.3. The air speeds required were less than 1 m/sec in the combustion chamber, 3 m/sec in the flue, and 4.4 m/sec at the bottom of the stack. With an air volume of 17,000 cu m/hr (25% of the capacity), the CO2 concentration was reduced from 100% to 50% at the boiler end in 158 sec (measurement) or 163 sec (calculation) and to 0% in 360 sec and 367 sec respectively. The frequency of air exchange was 3.1. Air speeds of 0.23 m/sec in the combustion chamber, 0.8 m/sec in the flue, and 1.2 m/sec at the bottom of the stack were necessary.

29685

Hirakawa, Hisaichi, Izumi Mizobuchi, and Toshiyuki Yamaie

DEVICE TO HOLD IN PLACE ATOMIZER NOZZLES OF A WASHER DEVICE FOR SULFUR OXIDE GAS CONTAINED IN COMBUSTION EXHAUST GAS FROM BOILER. (Boira no nenshogasu chu no sanka iwo gasu senjosochi ni okeru funmu nozuru coshaku sochi). Text in Japanese. (Hirakawa Tekkosho K. K. (Japan)) Japan. Pat. Sho 45-33635, Oct. 29, 1970, 4p. (Appl. Aug. 27, 1965, claims not given).

The atomizer nozzles for the sulfur oxide gas washing/reaction column can be easily installed at selected spots on the upper side of the column, using a device designed to facilitate the installation and allow more placement flexibility of the atomizers. The column is a part of the horizontal stack. Proper locations are selected on the top-side wall of the column and bored for installation of the atomizer nozzles. Box-like holders, one per each hole, are then fitted to the top-side wall of the column as if to cover the holes for atomizer nozzles. Each atomizer nozzle is connected to a pipe branched out from the main pipe connected to the alkaline water solution tank. To install the atomizer nozzles in the column, each nozzle unit is fitted in the hole bored in the top-side wall of the column and then held securely in place by means of a box-like holder in which the atomizer nozzle unit is held by a bolt screwed in from the top of the holder. This makes the installation much easier and permits easy relocation of the atomizer nozzles when necessary.

29686

DEVELOPMENT OF A NEW DUST COLLECTOR. (Kokuen o mushokuen ni joka - Shigenken ga shin shujinho o kaihatsu). Text in Japanese. PPM (Japan), 2(5):52-53, May 1971.

A new dust collecting system for a coal boiler and a new smoke density meter were developed. The dust collector is used to eliminate the dusts and particles from chimneys. The coal for combustion is packed in a bed and used as a filter to eliminate dusts from smoke. The coal then falls by gravity to the belt conveyer to be thrown into the combustion room. The black color of the smoke from the combustion room of the coal boiler almost disappears after the smoke passes through the coal packed bed of the system. The coal is dried in the bed by the heated gas, and consequently burns well and does not generate dust. The size of the equipment is 1.3 meters high, 1.3 meters wide, and 7 cm thick. The construction is very easy. The cost of construction is estimated to be about $3000. The new smoke density meter surpasses the conventional Ringelmann smoke density chart in many respects and is expected to be used in the future. It has a telescope, and the light through the projecting out objective lens of 8.5 magnifications is compared in the eyepiece with the light through the light-in window at which special light-intensity filters of ten grades responding to the smoke densities are equipped for reference. This smoke features easy handling, small personal error, the possibility of remote measurement (1 km), the possibility of the estimation of total smoke exhaust, and high precision.

29819

Kawashima, Shunkichi

ELECTRIC DUST COLLECTION DEVICE. (Denki shujin sochi). Text in Japanese. (Hitachi Seisakusho K. K. (Japan)) Japan. Pat. Sho 46-2640. 3p. Jan. 22, 1971. 2 refs. (Appl. Sept. 16, 1966, 1 claim).

The dust removal efficiency of an electric dust collector depends chiefly on the apparent specific resistance of the dust. An electric dust collection device was specially designed to remove dust from the exhaust gas of a boiler burning pulverized coal fuel. The dust in the exhaust gas gives a high specific resistance which should be lowered for an electric dust collector to remove dust efficiently. To lower the electrical resistance (to keep it within 0.0001 omega cm to 10 to the minus 11 omega cm), sulfur trioxide is injected into the exhaust gas. The dust collection efficiency increases with increase of the SO3 injection but reaches saturation at a certain point. Therefore, it is desirable to keep the amount of SO3 injected to a necessary minimum. Part of the exhaust gas from the pulverized coal boiler is taken out by a by-pass; then sulfur dioxide contained in the exhaust gas is reduced to SO3 by means of oxidation catalyst made from compounds of iron oxide, platinum, and vanadium. The produced SO3 is fed into the exhaust gas in the electric dust collector to adjust the resistance value. In the new device, exhaust gas from the boiler goes through the exhaust duct into the air preheater, then it goes through another duct into the electric dust collector unit; and finally it is blown out into the chimney by a blower. A smaller duct pipe branches out from the first exhaust duct and is connected to a small cyclone, or similar dust collector, which is equipped with a built-in converter. Part of the exhaust gas taken into the by-pass dust collector is cleaned, and the SO2 is reduced to SO3 by the converter at the same time. The SO3 gas is then fed back into the main dust collector by a blower fan through another by-pass.

29861

Busch, Hans-Peter and Friedrich Erwin Seese

THE NEW DUPLEX IRON MELTING PLANT AT THE M. BUSCH KG IN WEHRSTAPEL. (Neue Duplex-Eisenschmelzanlage bei der M. Busch KG in Wehrstapel). Text in German. Giesserei (Duesseldorf), 58(7):171-173, 1971.

A hot blast cupola furnace plant with two furnaces and an hourly melting capacity of 12.5 tons is described. The plant is equipped with a dust collection system comprising saturation apparatus, a venturi scrubber, a collector, a waste gas blower, and an exhaust pipeline for the cleaned gas. The annular chamber of the cupola furnace is equipped with a pressure-measuring probe. The measured pressure is relayed to a regulator from which impulses are sent to the motor that adjusts the dosing device for the waste gas. This method guarantees that all waste gas is passed to the dust collection plant. The path of the gas to the second furnace is blocked by water. The waste gas is drawn off just below the furnace throat and is cooled from 250-350 C to 80 C by saturation with water vapor. The gas next enters the venturi scrubber where the dust particles are thoroughly mixed with water and retained in the subsequent collector. The cleaned gas is then discharged through the stack.

29940

Hashizume, Minoru, Takeshi Iwasaki, and Kuro Shimoto

METHOD TO ARREST AND REMOVE WHITE SMOKE PRODUCED FROM MOLTEN ZINC PLATING PROCESS. (Yoyu aen mekki purosesu kara hassei suru hakue no haiki hoshu jokyoho). Text in Japanese. Preprint, Japan Society of Chemical Engineering, Tokyo, 3p., 1971. 1 ref. (Presented at the Japan Society of Chemical Engineering Convention, Annual, 36th, Tokyo, Japan, April 2-5, 1971, Paper E313.)

Equipment designed for the disposal of white fumes discharged from a melting kiln used in the batch type molten zinc plating process consists of a local exhaust hood, an exhaust duct, a fume/dust arresting device, and an exhaust blower. The white fume is produced in large quantities from thermal cracking of the flux when materials which are surface-treated with the flux are immersed in molten zinc for plating. It is also produced in large quantities as fumes of ammonium chloride when the NH4Cl powder is applied for additional treatment. The white smoke ascends with an ascending hot air current while diffusing. If a high canopy hood is used to arrest the white fume, it will require a tremendous exhaust wind volume which will in turn require a high-cost investment in a larger exhaust duct, dust collector, and exhaust blower. With the new equipment, this problem is solved by using local exhaust hoods combined with baffle plates and provided with slots. As a result, safety and sanitation problems caused by the white smoke are eliminated and the work efficiency is increased by 30%. Prior to designing the fume and dust arresting device, analysis of the white fume with amorphous filter paper, high-volume sampler, X-ray diffraction, impinger, ion analyzer, cascade impactor, and electron microscope showed its chemical composition to be mostly crystaline particulates of 3NH4Cl, ZnCl2, Zn(NH3)Cl2, NH4Cl2, and ZnO. It also contains a small amount of NH3 gas and H2O steam. The density of the fume particulates in the gas was 142 mg/cu m on the average and 1278 mg/cu m at a maximum. A total of 97-98% of the particulates was of sub-micron size, 1 micron or smaller. Of the sub-micron size particulates, the 0.4-micron size accounted for 51-54%. The fume particulates include ZnCl2 which is highly moisture-absorbent and easily condensed and solidified through reaction with the water in the air. These characteristics of the white fume make any inertial-type dust collection method impractical. The only applicable methods are either filtration or electrical dust collection. For economic reasons, the filtration method comprising a special device to prevent the filter cloth from becoming clogged with the arrested particulates was used with the equipment.

30055

Lee, G. K., F. D. Friedrich, and E. R. Mitchell

CONTROL OF POLLUTANT EMISSION AND SULPHURIC ACID CORROSION FROM COMBUSTION OF RESIDUAL FUEL OIL. PART I: LOW-PRESSURE HEATING BOILERS WITH MECHANICAL ATOMIZING BURNERS. Dept of Energy, Mines and Resources, Ottawa (Ontario), Canadian Combustion Research Lab., RR-195, 50p., Dec. 1968. 14 refs.

The burning of residual fuel oil containing 2.5% sulfur was tested in a pilot boiler by using low excess combustion air to control combustion conditions and by neutralizing sulfur trioxide and sulfuric acid with a fuel additive. The effects of boiler load, excess combustion air, mean residence time, and a magnesia-alumina fuel oil additive were tested on the formation of noxious and corrosive combustion products. The additive was an effective substitute for low excess air in reducing nitrogen oxides and SO3 emissions. Also, the additive neutralized condensed H2S04 and improved the electrical resistivity of soot to the point where soot electrostatic precipitation became feasible. The mechanism of acid soot neutralization and soot constituents were studied by a detailed analyses of particulate matter samples taken from flames with untreated oil and oil treated with three different amounts of additive. When soot or particulate matter is present, standard methods for measuring SO3 concentrations can give misleading results. Hycrocarbons and aldehydes in flue gas were relatively low, and carcinogens in the soot were present in less than trace amounts. (Author abstract modified)

30131

Ishibashi, Yasumasa and Masao Morita

STUDY ON DESULFURIZATION BY THE INJECTION OF LIMESTONE POWDER INTO FURNACE OF OIL FIRING BOILER (PART I). Text in Japanese. Mitsubishi Juko Mitsubishi Heavy Ind., Tech. Rev.), 8(2):207-214, March 1971. 6 refs.

The removal of sulfur dioxide from flue gas emitted by an oil-fired boiler by injecting alkaline earth additives such as limestone and magnesium hydroxide into the furnace was studied using a 125 MW boiler. Injection of the additives tended to raise steam and flue gas temperatures, however, the increases could be prevented by changing the injecting position. Pressure loss of flue gas was increased by the deposit formed on the surface of the reheater tubes and the blockage of the clinker at the primary superheater tubes. These deposits can possibly be controlled by soot blowers or protectors for reheater tubes. The SO2 removal ratio was 18-25% when the amount of limestone injected was equivalent to that of sulfur in the fuel oil; it increased with an increase in the amount of additive. The low removal ratio is due to the short residence time of additive particles in the flue gas and the unreactivity of SO2 to the additive at temperatures above 700 C. As far as the tested boiler is concerned, a higher removal rate cannot be expected without addition of some oxidizing catalyst such as Fe204 or Vs05. (Author abstract modified)

30155

Olds, F. C.

PROGRESS AND PROGRAMS IN AIR POLLUTION ABATEMENT. Power Eng., 75(6):54-56, June 1971.

Several examples are cited [illegible] illustrate the scope and variety of air pollution research programs conducted by the Division of Control Systems of the Office of Air Programs. These research programs relate to improved techniques for reducing pollution from stationary sources, and are directed toward the removal of pollutants from fuels before burning, control of combustion processes to minimize emissions, or cleaning of the discharged gases. Fluid bed combustion is a major DCS effort because of the high potential the removal of sulfur oxides builds into an economic system. Three systems are under investigation for sulfur and nitrogen oxides control. One is for a utility boiler at atmospheric pressure, a second for a boiler under pressure, and a third is an acceptor-fluidized bed to produce gas with combustion in a second stage. In another important, seven million dollar study underway at a power plant, a comparison is being made between wet (scrubbers) and dry (limestone injection) sulfur dioxide removal systems. DCS is also addressing itself to origin of submicron matter and the kinetics of its generation. Both the measurement and removal of these very small particles require new technology and equipment.

30159

THE DESIGN OF FLUID BED BOILERS. I. Steam Heating Eng. (London), 40(472):6-12, March 1971. 1 ref.

A discussion meeting on fluid bed boilers held recently was intended to provide the opportunity to review the state of fluid bed boiler technology, identify areas where work is required to solve immediate problems and where further research is necessary, and to discuss the potential offered by the development. In fluidized bed combustion, a bed of fine particulate inert solids is fluidized by air blown in from beneath. When the bed is heated and a fossil fuel injected, the fuel burns in the fluidized air and heat is rapidly transferred to all the solid particles in the bed. In a coal-burning system of this type, coal ash forms a suitable inert material for the bed. Among the advantages of the fluid bed system are reduced capital costs, excellent solid- gas contact, long solids residence time, and low operating temperatures. Recent experimental work indicates that the addition of limestone to the bed would result in 90% of the sulfur in coal being retained. This retention rate would meet U. S. requirements limiting sulfur dioxide in waste gases to 300 ppm. The main product of the reaction between sulfur and lime is CaSO4: the SO2 produced in the process of regenerating this to CaO could be recovered by processing to elementary sulfur or sulfuric acid.

30220

Yamada, Hiroshi

ON REMOVAL OF SULFUROUS ACID GAS FROM EXHAUST SMOKE. (Haien chu no aryusangas jokyo ni tsuite). Text in Japanese. Nenryo Oyobi Nensyo, (Fuel and Combustion), 38(2):32-39, Feb. 1971.

Although the use of low-sulfur crude oil or liquid natural gas fuel is most desirable for the reduction of sulfur dioxide in the fuel gas, the supply of these fuels is very limited. The desulfurization of heavy oil gives rise to the problem of marketing sulfur, its by-product. Another problem is that it gives a comparatively lower rate of desulfurization, i.e., 70-80% with the direct desulfurization and 30-40% with the indirect. To raise the rate of desulfurization, the process requires consuming a sharply increased volume of hydrogen, thus causing the cost of desulfurization to increase. The desulfurization of exhaust gas in a large-scale plant can achieve a desulfurization rate of up to 90%. The two methods may be used in combination for more economical desulfurization; the heavy oil desulfurization process performs the rough removal of sulfur, while the exhaust gas desulfurization removes the remaining sulfur content. Special boilers designed to burn high-sulfur heavy oil fuel may be installed and combined with a desulfurization device. In this connection, the flue gas desulfurization processes developed by Mitsubishi Heavy Industries were introduced, including the Mitsubishi Activated Manganese Oxide Method and the Mitsubishi Wet Lime Method. The former uses a powdered absorbent while the latter uses a lime-slurry absorbent. The activated manganese oxide method consists of a SO2 absorption process, an absorbent regeneration process, and an ammonium sulfate recovery process. The activated manganese oxide (MnOx nH2O) is fed and dispersed in the exhaust gas and reduced to manganese sulfate through a reaction with SO2 or SO3. The manganese sulfate and the absorbent that has not yet reacted with SO3 or SO2 are arrested by a multicyclone and electric dust collector, while the cleaned exhaust gas is discharged through the chimney. The wet lime method consists of a SO2 absorption process and a sulfite lime oxidation process. The exhaust gas is moistened and cooled to 60 C in a water spray tower to improve the absorption efficiency, thereby removing the dust and SO3 at the same time. The gas is then led to the first and second absorption towers. A milky solution of slaked lime (Ca(OH)2) is sprayed into the gas in the second absorption tower, so that SO2 in the gas can be removed as sulfite lime (CaSO3). The cleaned gas goes through the mist separator and is heated by after-burning; it is then discharged from the chimney.

30331

Moor, B. St. C.

NOTES ON AIR POLLUTION IN THE SUGAR INDUSTRY.
South African Sugar Technologists Assoc. Mount Edgecombe (Natal), Proc. South African Sugar Technologists Assoc., Annu. Congr., 44th, Mount Edgecombe, Natal, 1970, p. 54-56. (June 15-19.)

In the sugar industry, air pollution is primarily associated with the fall-out of incompletely combusted particles (smuts) from bagasse-fired boilers. The remedy lies either in prevention, by avoiding the generation of smuts, or in cure, by removing generated smuts from gases before their release. Preventive measures include adequate furnace area, draft controls on the boiler, increased boiler capacity, and addition of air heaters to promote combustion of the relatively moist bagasse. Some success in removing smuts from flue gas has been achieved with water sprays in a smuts chamber and as the result of filtering flue gases through a mesh stainless steel vibrator. The filtering system virtually guarantees the dry removal of 99% by volume of all particles over 0.25 mm and a large proportion of all finer particles. Disadvantages of the system are its costs and increased I.D. fan power requirements.

30488

Kuwaki, Motozo, Nobuo Ito, Isamu Maeda, and Ituo Tanaka

DEVELOPMENT OF REMOVING SO2 PROCESS FROM FLUE GAS, (SUMITOMO ACTIVE-CARBON ADSORPTION PROCESS BY GAS DESORPTION). (Gasu datsu shiki kasseitan ho ni yoru haigasu datsuryu sochi no kaihatsu). Text in Japanese. Sumitomo Jukikai Giho (Sumitomo Shipbuilding Machinery), 19(52):76-81, April 1971.

A new desulfurization process to remove sulfur dioxide from flue gas is described. The process, named Sumitomo Active-Carbon Adsorption Process with Gas Desorption, has proven to be industrially applicable by the successful operation of the pilot plant designed to treat flue gas of 10,000 N cu m/hr. Based on the sucess of the pilot plant, a larger-scale, semi-commercial exhaust gas desulfurization plant designed to treat gas amounting to 175,000 N cu m/hr, is now under construction. The Sumitomo Active-Carbon Adsorption Process consists of the adsorption of SO2 contained in the exhaust gas by the activated carbon, the desorption of the SO2, and the recovery of the SO2 separated from the activated carbon as concentrated sulfuric acid. In the adsorption process, the exhaust gas from a heavy oil-burning boiler is led into the adsorber. The adsorber is provided with a moving layer of granular activated carbon which moves from top to bottom. As the gas flows to cross the layer at a right angle, SO2 is adsorbed by the activated carbon. The exhaust gas is discharged through the flue and chimney while the activated carbon flows further downward to go out of the adsorber. In the desorption process, the activated carbon is fed into the separator or desorber where it is heated by an inert high-temperature gas and SO2 gas of 10% or higher concentration is separated. The activated carbon is returned to the adsorber for recirculation. The separated SO2 is recovered as 98% high-concentration sulfuric acid by the contact-type sulfuric acid manufacturing device. The features of the process are: a dry desulfurization process which results in no temperature drop of the treated gas and assures effective diffusion of the desulfurized gas; the adsorber employs a moving layer of activated carbon crossing the gas flow at a right angle so that dust will not deposit in the bed; the adsorbing bed is a moving layer of uniform thickness giving high efficiency of SO2 adsorption; safe processing method fully ensured against possible explosion; recovers high-quality 98% sulfuric acid of high economical value; and easy to control operation.

30612

Wierick, Dieter and Werner Schneider

QUALITY CRITERIA FOR AUTOMATIC OPTIMIZATION OF THE AIR/FUEL RATIO AND THE WASTE GAS TEMPERATURE OF PULVERIZED COAL-FIRED BOILERS.
(Guetekriterien zur automatischen Optimierung des Luftverhaeltnisses und der Abgastemperatur kohlenstaubgefeuerter Dampferzeuger). Text in German. Energie Tech., 21(5):207-213, May 1971. 22 refs. (Presented at the Kraftwerkstechnischen Kolloquiums der Sektion Energieumwandlung der Technische Universitaet Dresden, Nov. 1970.)

As quality criteria for the best air/fuel ratio, the minimum sum from waste gas loss and loss through gaseous and solid non-combusted matter, or the maximum boiler efficiency, is used. Optimization of the air/fuel ratio without considering the loss through solid non-combusted matter is not recommended because the efficiency is lowered and the heating surfaces must be cleaned more often. Since the optimum magnitude of the air fuel ratio changes with the operating conditions, an automatic optimization is advisable. The optimum waste gas temperature is then achieved when the sum total of fuel costs plus additional costs for low temperature corrosion are at a minimum. A regulating circuit can be used for adjusting the optimum waste gas temperature, which is found by continuous sulfur trioxide determination. 0 The adjustment is achieved through changing the operation of the air preheater.

30734

Jonke, A. A., E. L. Carls, R. L. Jarry, L. J. Anastasia, M. Haas, J. R. Pavlik, W. A. Murphy, C. B. Schoffstoll, and G. N. Vargo

REDUCTION OF ATMOSPHERIC POLLUTION BY THE APPLICATION OF FLUIDIZED-BED COMBUSTION. (ANNUAL REPORT). Argonne National Lab., Ill., Chemical Engineering Div., AEC Contract W-31-109-Eng- 38, Rept. ANL/ES-CEN-1002, 87p., 1970. 19 refs. NTIS: ANL/ES-CEN-1002

Combustion of fossil fuels in a fluidized bed, to which particulate limestone is added to react with sulfur oxides, is being studied as a means of reducing the emission of sulfur dioxide released during combustion. Coal has been burned in a six-inch diameter bench-scale combustor to study the following: the effect on SO2 removal of the limestone particle size, type of limestone, temperature, calcium to sulfur ratio, fluidized-bed depth, and recycle of elutriated fly ash to the bed; the extent of calcination and sulfation of limestone; and factors affecting the nitric oxide concentration in the flue gas. In natural gas combustion experiments, measurements were made of the extent of SO2 removal, the NO level in the flue gas, and the combustion efficiency. Mathematical models have been developed to estimate the extent of reaction of limestone with SO2 during coal combustion and the effect of nonuniform feeding of coal on combustion efficiency. (Author abstract)

30926

ADDITIVES CUT POLLUTION WHEN FIRING RESIDUAL OILS. Mod. Power Eng., 65(6):70-71, June 1971.

Most residual oils contain vanadium, sodium, and potassium compounds. These harmful metals act as catalysts for the formation of sulfur trioxide from the sulfur oxides produced by the burning of sulfur, the other major noncombustible material in the oils. The sulfur trioxide, which reacts with moisture to form sulfuric acid, leads to low-temperature corrosion. This and other problems, such as oil ash corrosion and slag formation in superheaters and sludge buildup in tanks or piping, are alleviated by metal-based pre-combustion and combustion additives. These additives come in solutions of oil-soluble compounds or suspensions of micron sized dispersed particles, with metal oxide content from less than one percent to more than 50%. For boilers, the most promising additives appear to be magnesium, manganese, or a mixture of magnesium and aluminum. A magnesium-silicon additive improves the efficiency of gas turbines operation on residual fuels, while silicon additives increase diesel engine exhaust valve life.

30994

Argonne National Lab., Ill., Chemical Engineering Div.

FLUIDIZED-BED COMBUSTION OF FOSSIL FUELS. In: Chemical Engineering Div. Research Highlights. Rept. ANL-ES/CEN-FB1000, Rept. ANL-ES/CEN-FB1000, p. 67-68, 1969. 2 refs. NTIS: ANL-7650

The fluidized-bed technique is being investigated as a possible way to reduce the emission of atmospheric pollutants in the combustion of coal. The concept involves the introduction of fuel and a sulfur dioxide-reactive additive (such as limestone) into a hot fluidized bed of solids. The solids consist of small particles of noncombustible material, such as ash, held in a dense suspension by a stream of air passing upward through them. As it mixes with the bed material, the fuel burns. The heat generated is transferred to boiler tubes immersed in the fluidized bed, and simultaneously SO2 reacts in situ with the additive material. A six-inch diameter, bench-scale fluidized-bed combustor was constructed, together with a preheater, three feeders, and two cyclones. Initially, exploratory bench-scale experiments were performed to aid in the selection of operating conditions. Next, a systematic set of bench-scale experiments were performed to investigate the emission of SO2 under conditions applicable to conceptual designs of both utility-sized power generating stations and industrial steam boilers. The variables considered were the particle size of the limestone additive, the superficial velocity of fluidizing gas, and the recycling or nonrecycling of elutriated solids to the fluidized-bed combustor. The major results of the bench-scale experiments, which were all conducted at a combustion temperature of 1600 F and a superficial gas velocity of 3 ft/sec, are indicated.

31100

Jonke, A. A., E. L. Carls, G. J. Vogel, L. J. Anastasia, R. L. Jarry, and M. Haas

REDUCING POLLUTION FROM FOSSIL FUEL COMBUSTION. Instr. Control Systems, 44(7):95-98, July 1971. 4 refs.

The reduction of sulfur dioxide and nitric oxide emissions from boilers using fossil fuels is discussed. A fluidized bed is an efficient contact medium for gas-solid chemical reactions, and injection of material that reacts with SO2 provides a means of efficient emission control. Also, low combustion temperatures offer a potential means of reducing NO emissions. Sulfur dioxide and sulfur trioxide emissions can be controlled by feeding coarse solid materials, such as limestone, to the bed which react with these gases to form sulfate compounds. When limestone was fed at twice the stoichiometric rate needed to convert all sulfur to calcium sulfate, the sulfur in the flue gas was decreased by 70-90%. Tests using natural gas, which does not contain nitrogen compounds, showed an NO level in the fluidized bed effluent of only 60-90 ppm. Such fuels, therefore, can apparently be burned in fluidized beds with relatively low NO emissions. Thus, boilers using fluidized-bed combustion show promise of being cheaper, more compact, and more efficient than conventional units.

31104

Jones, Ben G.

REFINERY IMPROVES PARTICULATE CONTROL. Oil Gas J., 69(26):60-62, June 28, 1971. (Presented at the National Petroleum Refiners Association Meeting, San Francisco, California.)

Electrical precipitators at a refinery control particulate emissions with efficiencies of 94.6% at the cat cracker, 98.7% at the coker, 99.3% at the boiler house, and 99.7% at the coker hopper. The efficiency attained by the cat-cracker precipitator is due to a voltage control mechanism called Anacomp. In this system, a silicon control rectifier replaces the original saturable core reactor for voltage control. The installation eliminates electrical breakdowns and failures. With it, the precipitator now meets regulations limiting particulates to 40 lb/hr and to an opacity below Ringelmann 1. Data on size, operating conditions, and gas composition are given for each precipitator unit.

31145

Kawashima, Shunkichi and Yoshio Matsumoto

ELECTRIC DUST COLLECTOR. (Denki shujinki). Text in Japanese. (Hitachi, Ltd., Tokyo (Japan)) Japan. Pat. Sho 46-21153. 3p., June 15, 1971. (Appl. Dec. 1, 1967, 1 claim).

An electric dust collector, used for removing the sooty dust from the exhaust gas of a boiler uses finely powdered coal as fuel, is described. The apparent resistance of sooty dust lowers the efficiency of an electric dust collector. When finely powdered coal is burned, this electric resistance is especially strong, so that the electric dust collector cannot function fully. The new collector aims at lowering the electric resistance to improve its efficiency. The electric dust collector has a side channel in the smoke duct through which a part of the cleaned gas is extracted. In the side channel, there is a device which converts sulfur dioxide into sulfur trioxide in the prsence of a catalyst. The SO3 thus formed is poured into the smoke duct before the inlet of electric dust collector. In the side channel, there is a converter and a small supplementary dust collector which eliminates dust from the gas extracted. Within the converter, using an oxidation catalyst, such as an oxidized iron, platinum, or vanadium compound, SO2 in the gas is converted to SO3, which is sent to the smoke duct before the electric dust collector by means of a supplementary blower. Sulfur dioxide, oxygen, and ozone in the cleaned gas are changed into SO3, by various reactions. Sulfur dioxide exists in the range of 700 ppm - 2400 ppm in exhaust gas from the boiler. The electric dust collector is operated by selecting the catalyst, in accordance with the SO2 concentration for the converter, and calculating the necessary amount of SO3. There is no need to supply SO3 from the outside. Since the reaction occurs in the cleaned gas, the catalyst is very durable, and little is lost in the reduction and reuse of the catalyst.

31229

Tomany, J. P., R. R. Koppang, and H. L. Burge

A SURVEY OF NITROGEN-OXIDES CONTROL TECHNOLOGY AND THE DEVELOPMENT OF A LOW NOX EMISSIONS COMBUSTOR. J. Eng. Power, 93(3):293-299, July 1971. 9 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, New York, N. Y., Nov. 29-Dec. 3, 1970, Paper No. 70-WA/Pwr-2.)

The problem of nitrogen oxides (nitric oxide, nitrogen dioxide are major pollutants) emissions reduction is gaining increased attention from those concerned with air pollution control activities. The Los Angeles Air Pollution Control District has published regulations which limit emissions from combustion sources to a fixed rate of 140 lb/hr. This is equivalent to an allowable emission concentration of 20 ppm for a 500 MW power station. Two of the major contributors to nitrogen oxides pollution are industrial processes and stationary combustion sources, which are responsible for over 50% of the total nitrogen oxide emissions. Motor vehicles contribute the remainder, for a total of 20 million tons/yr. Although some advances have been made in the development of commercial control equipment for industrial process emissions, there is little well-developed technology for stationary combustion sources. Two of the most promising areas being studied are: stoichiometric variations of the air-fuel feed and partial recycling of the combustion products, and advanced design of combustion equipment. The former control system has reduced nitrogen oxides emissions from 350 to 150 ppm in a test program with 17 commercial boilers. An advanced design combustor has produced values of about 150 ppm. When coupled with simulated combustion gas recycle, the emissions were further reduced to 100 ppm. Other control methods include catalytic reduction, scrubbers, and desulfurization of fuels. (Author summary modified)

31404

Ingraham, T. R. and P. Marier

MECHANISM OF THE ABSORPTION OF SO2 BY LIMESTONE. J. Air Pollution Control Assoc., 21(6):347, June 1971. 3 refs.

When finely powdered limestone is injected into the hot flue gases in a steam boiler, it calcines rapidly to produce calcium oxide. As the gases cool, the CaO begins to combine with sulfur dioxide. The final reaction product is calcium sulfate, and the reaction systems involved in the conversion of limetone to CaSO4 are presented. Calcium sulfite, which is an intermediate in the formation of calcium sulfate from CaO and SO2, is formed rapidly at temperatures as low as 330 C. At temperatures above 650 C, it is thermally unstable in an inert atmosphere. There are two competing processes in its decomposition. One liberates SO2 and forms CaO, the other forms a mixture of CaS and CaSO4. The latter process predominates except under vacuum. Calcium sulfite may be readily oxidized to CaSO4 by oxygen, SO2, or sulfur trioxide.

31456

Miura Kagaku Sochi K. K. (Japan)

ON DESULFURIZATION OF EXHAUST SMOKE BY TURNING-FLOW GAS LIQUID CONTACT METHOD. (Senkairyu kieki sesshokoho ho yoru haien datsuryu ni tsuite). Text in Japanese. Nenryo oyobi nensyo (Fuel and Combustion), 38(5):51-58, May 1971.

A conventional wet type desulfurization/dust removal method designed to clean exhaust gas usually requires 20 l wash water/cu m of gas to be treated. Suppose the water consumption is 10 l/N cu m the total amount of waste water will be 500 T/hr when an exhaust gas of 50,000/N cu m/hr is treated. It thus requires a great amount of extra cost to treat the waste water. Designed to minimize the water consumption, and yet assure high efficiency of dust removal and desulfurization, are the Blue Bird, a scrubber for dust removal, and the Totempole, another scrubber for the removal of sulfur dioxide absorption of gas, and removal of odors and fumes from boiler exhaust gases. Two cages with a number of tangential slits are provided within a bottle-like cylindrical unit. The lower one is the intake cage, and the upper is the discharge cage. The gas intake port is provided in the lower side of the cylindrical unit. This assembly of the cylindrical casing, the intake cage, and the discharge cage makes the basic unit. The Blue Bird consists of one basic unit, while the Totempole has two or more basic units. With the Blue Bird, the dust-containing exhaust gas flows into the intake cage through the slits at a velocity of 15-25 m/sec and moves upward turning at the high speed. It is then discharged at the same velocity through the tangential slits of the discharge cage. The slits are 3 mm, 5 mm, or 10 mm wide, so that the high-speed gas atomizes water membranes, formed on the inner walls of the slits, as it flows through. Since there is a high-speed turning current in the cage, the atomized water droplets are driven toward the inner walls of the slits by the centrifugal force, and form water membranes. The dust is also driven toward the inner walls of the slit by the centrifugal force, and are thus arrested by the water membranes. The water, having now adsorbed the dust, is discharged through the slits of the discharge cage together with the gas that it turning at the high speed. The dust is then separated from the water in a centrifuge provided above the scrubber unit. Similar principles applying to the Totempole, except that the scrubbing is repeated at several stages, since the gaseous substances or fume-like micron dusts are too small to be removed by a one-stage process.

31662

Frazier, J. F.

REMOVAL OF SULFUR OXIDES FROM INDUSTRIAL BOILER FLUE GASES. Natl. Eng., 75(8):6-9, Aug. 1971. 4 refs. (Presented at the Illinois State NAPE, Pollution Control Conference, 3rd.)

The problem is to remove sulfur dioxide from flue gases without removing non-contaminants at the lowest possible cost. At this time, the scrubbing or washing of flue gases with an alkaline additive appears to be a practical way to remove sulfur products from industrial boiler stack gases. A system is described which consists of washing the stack gases with a weak solution of sodium hydroxide or soda ash, as either is converted by the carbon dioxide to sodium bicarbonate, which reacts with SO2 to form sodium acid sulfite. A schematic flow system, chemical reactions, and factors for estimating quantities are presented. A secondary chemical treatment system consists of treating the sodium acid sulfite with calcium hydroxide to precipitate insoluble calcium sulfite which can be disposed of with the boiler ash. Costs are cited.

31795

Morse, W. L.

SMUTTING OF OIL-FIRED BOILERS AND ITS CORRECTION BY THE DCP SYSTEM. Plant. Eng. (London), 14(8):186, 191-192, Aug. 1970.

The D.C.P. Systems Ltd. method of injecting powder and oil-fired boilers is described, to prevent acid smuts from chimneys falling all around on property, cars, washing, and so forth, and to keep flues clean, so that weekend shutdown time is reduced. In the basic installation, a very fine spray of alkaline powder, (consisting mainly of calcium and magnesium carbonates), is injected into the flue gases to neutralize and dry up the acid condensation, and prevent the formation of carbon agglomerates. A special insufflator, the Alkajector, is used to inject the powder where it is most likely to be effective.

31990

Minemura, Katsuya

DESULFURIZATION OF STACK GAS BY ROTARY WASHING METHOD. (Kaiten senjoho ni yoru haien datsuryu). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(7):46-51, July 1971.

No adequate equipment for the control of sulfur oxides has been found for the smaller boilers used for heating buildings. Recently, a rotary washing method has been utilized by the National Telegraph and Telephone Public Corporation to prevent the deterioration of their equipment by sulfuric acid gas. The rotary economizer recovers heat from boiler exhaust. The aim was to devise a sulfur dioxide control apparatus which was as compact as possible, and rotary equipment was selected since it has good contact between air and liquid. Gas absorption and dust elimination can be carried out simultaneously. Sulfuric acid gas can be absorbed in a short period of time when an alkali solution is released by the rotary sprayer in fine droplets. Very little special metal is used, so that the cost is low, and little maintenance is required, as the structure is simple.

31997

Walsh, W. H. and J. A. Waddell

OBTAINING AND MAINTAINING LOW EXCESS AIR OPERATION ON AN INDUSTRIAL BOILER. Preprint, Illinois Inst. of Tech., Chicago, Technical Center, 8p., 1971. (Presented at the American Power Conference, Annual Meeting, 33rd, Chicago, Ill., April 20-22, 1971.)

The problem of the fouling of the regenerative air heater surface of a steam generator due to acid condensed on the air heater surfaces is examined. More accurate use of the air warmer and conversion to low excess air firing in order to minimize the formation of sulfur trioxide are discussed as solutions. Satisfactory combustion conditions were established when carrying 15% excess air; with 10% excess air, operation became unsatisfactory. To improve operation with 5% excess air, mechanical analyses were made of control system tuning, air quantity in the burners, spray angles for the steam atomizing burner nozzles, and steam atomizing oil guns. Air preheater plugging was examined by use of a sulfur oxide analyzer and an acid deposition rate probe. No stack emissions were observed when the unit was operating at 265,000 lbs of steam per hour, or 88% of maximum continuous rating, with 3% excess air (0.6% oxygen), 3.1% sulfur oil, and an ambient temperature of 26 F.

32274

Hammons, G. A. and A. Skopp

A REGENERATIVE LIMESTONE PROCESS FOR FLUIDIZED BED COAL COMBUSTION AND DESULFURIZATION. (FINAL REPORT). Esso Research and Engineering Co., Linden, N. J., Government Research Div., APCO Contract CPA-70-19, APTD-0669, 115p., Feb. 28, 1971. 21 refs. NTIS: PB 198822

An experimental study was conducted on a fluidized bed coal combustion system using lime as a bed material. The lime reacts with sulfur dioxide and oxygen to form calcium sulfate under oxidizing conditions, thus reducing SO2 emissions. The regeneration reductive of the sulfated lime back to CaO and recycle of the generated lime back to the combustor was investigated as a method of reducing fresh limestone feed rates to the system. The maximum efficiency of the three-inch diameter coal combustor used was 97% at a bed temperature of 1800 F, a superficial gas velocity of three ft/sec, and an excess air level of ten percent. The combustion efficiency decreased as bed temperature decreased, increased as superficial gas velocity decreased, was independent of the excess air level over a range of seven to 30%, and decreased with increasing bed height. Experiments were conducted in the fluidized bed combustor with batch charging quantities of freshly calcined lime. Experiments were also performed with respect to nitric oxide emissions. The NOx emissions from the fluidized bed combustor in a typical batch lime operation decreased as a run progressed. The reductive regeneration of the partially sulfated lime back to CaO was investigated. An economic comparison of the two fluidized bed boiler systems is included. (Author abstract modified)

32414

Barrett, R. E. and D. W. Locklin

INDUSTRIAL STEAM GENERATION AND COMMERCIAL AND RESIDENTIAL HEATING. In: The Federal R and D Plan for Air-Pollution Control by Combustion-Process Modification. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., 1971, APCO Contract CPA 22-69-147, Rept. APTD-0643, p. V-1 to V-47, Jan. 11, 1971. 48 refs. NTIS: PB 198066

Energy-conversion devices within the source category of industrial steam generation and commercial and residential heating are used primarily for converting chemical energy in fuel to thermal energy in the form of steam, hot water, or warm air. Possibilities for pollutant emission reduction by combustion modification are discussed as they pertain to steam generation, space heating, and service water heating. Principal fuels utilized for these applications include: bituminous coal, small quantities of anthracite coal and lignite, residual fuel oil, distillate fuel oil, propane and butane, and natural gas. Pollutant emission levels are mentioned for products of incomplete combustion, nitrogen oxides, sulfur oxides, fly ash, and other noncombustible particles. The empirical knowledge relating combustion variables to emissions is cited, as well as combustion equipment development, techniques for lowering peak gas temperatures, flue-gas recirculation, and other techniques for achieving low-temperature combustion. Servicing and maintenance, additives and emulsions, and fluidized-bed combustion are discussed. Current and relevant combustion research and development are summarized.

32455

Walker, A. B.

EFFECTS OF DESULPHURIZATION DRY ADDITIVES ON THE DESIGN OF COAL-FIRED BOILER PARTICULATE EMISSION CONTROL SYSTEMS. Can. Mining Met. Bull. (Montreal). 64(713):85-90, Sept. 1971. 11 refs. (Presented at the Canadian Institute of Mining and Metallurgy, Annual General Meeting, 73rd, Quebec City, Quebec, April 1971.)

The effects of the injection of dry limestone additives into boilers for the sorption of sulfur dioxide were studied in pilot and full-scale systems. Implications of the effects on the design and economics of particulate collectors, in particular electrostatic precipitators, are discussed. The injection of calcium or magnesium-base additives into boilers for flue gas desulfurization will have a significant effect on the economics of the collection of fly ash and reaction products. The effects can be minimized if precipitators are either modified or initially installed to operate at temperatures in excess of 600 F. (Author abstract modified)

32524

Mizukami, Yukihiro

AIR POLLUTION AND DISTRICT HEATING IN SAPPORO CITY. (Sapporo shi no taiki to chiiki danbo keikaku osen). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 9(1):45-51, April 1971.

Beginning each November, Sapporo City suffers from heavy smog. Air pollution in Sapporo, which first became a problem in 1955, is due to boilers for heating, black smoke and harmful gas from domestic-stove chimneys, and automobile exhaust. On the advice of the Antismoke Council, an ordinance against black smoke went into effect in June 1962. In July 1966, the council (enlarged and renamed the Sapporo City Antipollution Council) recommended two permanent air pollution control measures: the adoption of district heating in congested areas where large boilers are used and, where possible, in residential areas; and the mass production of smokeless solid fuel for home and school use. Since reaching a peak in 1961, the volume of dust periodically measured at 10 points in Sapporo has gradually decreased. The 1965 volume was 55% of the 1961 volume and the 1969 volume was 31% of the 1965 volume. The reduction is the result of improved incinerator facilities and control methods, and the switch from coal to oil in 1962/1963. In the center of Sapporo, dust volume is still three to four times greater than in other areas. Between 1966 and 1970, the number of large boilers in Sapporo increased from 1500 to 2100. Of this number, 20% are located in the 1.35-sq-cm central area.

32552

Clain, F.

A DISTRICT HEATING AND COOLING DISTRIBUTION SYSTEM SENRI NEW TOWN. (Une distribution de chaleur et de froid a distance: Senri New Town). Text in French. Promoclim., 1(9):567-584, 1970.

Senri New Town, a new urban complex under construction at Osaka, Japan will be served by a central water heating and cooling distribution system. The advantages of a central heating and cooling system, as opposed to a multiple system, are lower initial investment, saving in fuel consumption, lower fuel costs because of bulk purchasing, reduction of the number of attendants, reduction of atmospheric pollution, reduced fire hazard, and saving in space. Calculations disclosed that while a conventional multiple heating system would add 0.24 ppm sulfur dioxide at ground level to the existing SO2 concentration, a central heating system would add only 0.0002 ppm SO2 to existing SO2 pollution at a distance of 13 km from the stack. The Senri installation (resembling that of Hartford, Conn.) will furnish water of two temperature ranges between 120 and 180 C and between five and 13 C. The central heating and cooling plant will occupy 13250 sq m and will consist of five gas-heated steam boilers, of absorbers, and five turbocompressors. The boilers produce steam fed into primary heat exchangers which heat water to 120-180 C. Cooling water is produced by passing it through a series of turbocompressor evaporators. Centrifugal compressors are activated by steam turbines fed from boilers. The hydraulic aspects of hot and cold water distribution is outlined.

32751

Shimada, Saburo and Kazuyoshi Shimizu

STEEL DOUBLE-TUBE CHIMNEY EQUIPPED WITH HEATING ELEMENT AND HEAT- INSULATING MATERIAL. (Haigasu no kanetsu oyobi reikyaku boshi yo koban sei niju entotsu). Text in Japanese. (Ishikawajima- Harima Heavy Industries (Japan)) Japan. Pat. Sho 46-24945. 2p., July 17, 1971. 1 ref. (Appl. Aug. 4, 1965, 1 claim).

An exhaust gas temperature drop and/or lower temperatures of the inner wall of the stack are believed to effect the formation of acid smuts in stacks. Acid fumes are likely to develop and be discharged into the atmosphere particularly when boilers have just been started, causing serious air pollution problems. A double-tube steel chimney was designed to prevent acid smut formation by keeping the exhaust gas hot. An electroheating tape or small steam pipe is wound spirally around the inner tube of the chimney. The space between the inner tube and the outer tube is then packed with a heat-insulating material to keep the inner tube from cooling.

32803

Sato, Takahisa and Yoshiyasu Sakai

DESULFURIZATION EQUIPMENT OF STACK GAS BY NTC WET SYSTEM PROCESS. (NTC shiki shisshiki haien datsuryu sochi). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(8):61-65, Aug. 1971.

Sulfur oxides in boiler exhaust gas are controlled by a liquid-gas contact, absorption process. Alkaline effluents discharged from the plant are utilized in a four-stage spray device. Sodium hydroxide, calcium monoxide, and calcium carbonate can be used in plants which do not produce an alkaline effluent. The liquid is sprayed under pressure in order to well mix the liquid and gas. Sodium sulfite is generated. Liquid from the reaction area is sent to an effluent treatment area which maintains an alkaline pH. Thus, sulfur dioxide is eliminated. Equipment costs and operation costs are low. The equipment is simple and easy to maintain.

32824

Ozawa, Toshio

WET TYPE DESULFURIZATION EQUIPMENT. (Shisshiki haien datsuryu sochi). Text in Japanese. Preprint, Reutilization of Resources Technical Assoc. (Japan), 7p., 1971. (Presented at the Seminar on Reutilization of Resources Technology, 2nd, Japan, July 12-14, 1971), Paper 7).

A venturi scrubber with a caustic soda liquid is used to absorb sulfur dioxide from boiler waste gases. Dust can be eliminated at the same time. The scrubbing liquid is sent through a settling tank and filter, and the waste is solidified so that there is no danger of effluent pollution. Stainless steel equipment is used to prevent corrosion. As the absorbing liquid forms droplets, its surface area increases, thus providing for effective contact with the gas. The equipment is simple and automatic. Then sulfurous acid soda of high purity is recovered.

32826

Inagaki, Koshiro

DESULFURIZATION OF SMOKE USING NEW DESULFURIZING CHEMICAL. (Shin datsuryuzai shiyo ni yoru haien datsuryu jitsuyo shiken). Text in Japanese. Preprint, Reutilization of Resources Technical Assoc. (Japan), 8p., 1971. 1 ref. (Presented at the Seminar on Reutilization of Resources Technology, 2nd, Japan, July 12-14, 1971, Paper 6.)

A tower packed with an activated charcoal impregnated with a metal oxide catalyst is described for removing sulfur oxides from smoke emissions. The metals can be copper, nickel, chrome, cobalt, or molybdenum. Fabrication of the catalyst to make it especially acid-resistant is discussed. Construction and operating costs are low since only one tower is required. Since the catalyst carrier is spherical, there is little friction resistance, and it is easy to maintain. The tower is noiseless, compact, and very efficient even after four hours of continuous operation. This method can be applied to very small or very large boilers.

32827

Kurosawa, Kenji

DESULFURIZATION OF STACK GAS BY WL-NA PROCESS. (Ueruman rodo ho ni yoru haiendatsuryu). Text in Japanese. Netsu kanri (Heat Management: Energy and Pollution Control), 23(8):46-49, Aug. 1971. 1 ref.

The WL-sodium method went into trial operation in June of this year at a synthetic rubber company plant to recover pure sulfur dioxide from boiler stack gas and produce high concentration sulfuric acid. Near-saturation sodium sulfite is used to absorb the SO2 at about 60 C. When heated to about 100 C, SO2 and Na2SO3 are recovered. The Na2SO3 crystal is dissolved and recycled as absorbing liquid. The SO2 is cooled to remove water, mixed with air, and sent to the contact sulfuric acid equipment. Automatic control is possible since very little handling of solids is required. SO2 in the stack gas is maintained at less than 200 ppm. Construction and operating costs are low. About 200,000 N cu m/h stack gas from the boiler is desulfurized.

32906

Nojiri, Hideo

DUST REMOVER FOR DUSTY GAS. (Ganjin kitai yo jojin sochi). Text in Japanese. (Mitsui Miike Seisakusho Co. (Japan)) Japan. Pat. Sho-14638. 3p., April 19, 1971. 2 refs. (Appl. Feb. 18, 1971, 1 claim).

A dust remover for high-temperature dusty gas from boilers or heating furnaces is presented. The top of the filter unit, contained in a box-like casing, is a detachable cover, and the front upper part is cut as a gas intake port, covered with a rectangular plate with several nine-mesh holes. Two shelf plates, also with nine-mesh holes, are placed one above the other and spaced in the lower part of the casing. Coarse pebbles, five-seven micron in size, are packed between the shelf-plates, with a layer of two-four micron pebbles on the upper shelf plate. The compartment between the lower shelf plate and the casing bottom is the suction chamber, connected to the suction pumps by ducts. Several units are lined up at varying heights within the dust remover. The gas intake pipe is connected to the top of the dust remover; the discharge port is at the bottom. Several gas diffuser plates are installed immediately under the top of the dust remover for uniform distribution of the gas to all filter units. The gas enters the filter unit through the holes of the gas intake port cover and is sucked down through the pebble layers into the suction chamber and out of the unit through the pump. The dust accumulated on the top filter layer is blown off by air from the suction chamber, leaves the filter unit through the holes of the port, and falls on the main casing of the dust remover.

32910

Kobayashi, Hiroshi and Shoyo Kawabata

SOOTS-REMOVING DEVICE FOR PRESSURE COMBUSTION TYPE SMOKE TUBE BOILER. (Kaatsu nensho gata enkan boira ni okeru baifun haijo sochi). Text in Japanese. (Hirakawa Tekkosho K. K. (Japan)) Japan. Pat. Sho 46-26721. 3p., Aug. 3, 1971. (Appl. Nov. 27, 1968, 2 claims).

A pollution control device is presented which removes the soot from the furnace tube and smoke pipes by accelerating the speed of the air blower. The smoke tube boiler is positioned horizontally in a tubular main casing, with a smaller inner tube in the lower half of the main casing interior which serves as the furnace tube. An oil burner whose tip is in the air chamber between the front of the main casing and the furnace tube, is installed in the front of the main casing. An air blower, outside the main casing and connected to the air chamber by ducts, supplies primary and secondary combustion air. Several small smoke pipes are installed horizontally parallel to the furnace tube. The rear smoke chamber is directly inside the back of the casing, and the front smoke chamber is above the air chamber and directly connected to the upright stack. As the burner is ignited, the flame jets into the furnace tube and produces combustion gas which flows toward the rear smoke chamber, turns upward and through the smoke pipes, and reaches the front smoke chamber to be discharged. The control device necessitates that the front smoke chamber be divided by a vertical partition plate which extends into the upright stack. Two independent dampers, which may be operated manually from the outside, are installed in the divided stack for each half of the smoke chamber. When the boiler is operating, they are kept open. When the inside of the smoke pipes must be cleaned, one damper is closed and the blower operates at full speed to blow away the soot. The blower is directly connected to the front smoke chamber by an extra air duct and enables the cleaning air to flow through the pipes opposite to the normal flow of the combustion gas.

33030

Monkhouse, A. C. and H. E. Newall

INDUSTRIAL GASES--RECOVERY OF SULPHUR DIOXIDE. Society of Chemical Industry, London (England), Disposal Ind. Waste Mat. Conf. Sheffield, England, 1956, p. 103-107. 17 refs. (April 17-19.)

Developments in the recovery of sulfur dioxide from waste industrial gases are reviewed, and commercial processes for the recovery of sulfur dioxide from smelter gases are briefly described. An important modification of the chamber sulfuric acid plant, used on the Continent, is the Petersen process in which packed towers replace the chambers and high concentrations of oxides of nitrogen are circulated. The Kachkaroff process is similar and also utilizes a high concentration of oxides of nitrogen. Processes, other than standard methods of sulfuric acid manufacture, have been used, or are in use, for the recovery of sulfur dioxide from gases containing 1-7% of SO2. The most important of these are the dimethylaniline process, the Lurgi Sulphidine process, the I.C.I. process, and the Trail ammonia process. The more difficult problem of developing a technically and economically satisfactory method of recovering SO2 from boiler flue gases containing very low concentrations of SO2 is exemplified by descriptions of two processes that have been operated on a full scale, and of others at the pilot-plant stage of development. Scrubbing with water, with an organic base and with an aqueous solution of an inorganic base or with the sulfite of the base are noted. Electrical oxidation and fixation of SO2 as a dry solid compound are also mentioned. (Author summary modified)

33288

Godel, Albert and Paul Cosar

THE SCALE-UP OF A FLUIDIZED BED COMBUSTION SYSTEM TO UTILITY BOILERS. Preprint, Activit, Paris (France) and Babcock Atlantiqu Paris (France), 31p., 1971 (?). 10 refs.

Fluidized bed technology as applied to the coal combustion processes was reviewed. The principles of traditional combustion methods and combustion in fluidized beds, the origin, principle, and industrial development of the ignifluid process, and the correlation with air pollution were examined. The overall result of the combustion was a reducing gas; the amount of nitrogen oxides in the flue gases was about half of that from emission from conventional furnaces. Particle discharge was not specifically problematic, but the high carbon content of the fly ash and the relatively coarse size of the particles which were totally recycled to the fluidized bed were considered. The low excess air reduced the rate of conversion from sulfur dioxide to sulfur trioxide to a minimum. The scale-up of the process to the utility boilers level is described with respect to the steam cycle, automatic control of the furnace, including primary and secondary air control, coal feed control, and total air pressure control, and a comparison with other fluidized bed combustion systems.

33603

Dittrich, A.

ATMOSPHERIC GAS BURNERS AND HEATING BOILERS. (Atmosphaerische Gasbrenner und Heizungskessel). Text in German. Oel Gasfeuerung, 16(10):971-976, Oct. 1971.

In countries with large natural gas supplies, boilers with atmospheric burners for heat production are preferred. For carbon monoxide-free combustion, the exit speed of the fuel gas from the injection nozzle must be between 0.3 to 0.6 m/sec corresponding to the maximum pressures of 80 mm at city gas and 180 mm at natural gas. About 40 to 48% of the total primary air for combustion must be drawn along with the fuel. An insufficient secondary air supply leads to CO formation which is optically recognizable by the yellow flame.

33623

Eick, H.

SERVICE FOR HEATING SYSTEMS. (Service fuer Heizungsanlagen). Text in German. Oel Gasfeuerung, 16(10):958-964, Oct. 1971.

For proper functioning of oil heaters it is always important to adjust the burners properly. The combustion efficiency or the waste gas loss depends on the carbon dioxide content and on the waste gas temperature. Measures which reduce the waste gas temperature at high CO2 values improve the efficiency more than efforts aiming at a more complete combustion. The waste gas losses depend on the waste gas quantity and the temperature. It is desirable to operate with a minimum of excess air. The combustion process can be termed efficient when a synthesis between highest achievable CO2 content and lowest permissible soot number is accomplished. The pressure atomizers which are usually used for oil-fired boilers have a narrow range in which a relative high CO2 content and a soot number below two (according to DIN standard 4787) can be maintained. At lower air surplus or higher CO2 content, the soot number increases in similar manner as at higher air surplus and low CO2. The soot number and the quantity of carbon particles in the waste gas should be periodically monitored.

33734

Nakamura, Kiyohiko

PREVENTION OF ACID SMUT FROM SMALL SIZE OIL FIRING BOILER. (Kogata juyu boira no entotsu kobai boshirei). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(9):29-33, Sept. 1971.

A small boiler (with a maximum steam quantity of 1750 kg/h and a combustion chamber of 2.8 cu m) produced a great quantity of acid smut. It was remodelled with the following improvements in mind: complete combustion of soot, low oxygen combustion in order to prevent sulfur dioxide and sulfur trioxide formation, a higher stack for better smoke dispersion, a faster stack gas emission rate, a higher stack gas temperature, a constant operation of the boiler to prevent pressure variance in the flue and stack, elimination of dead space, better ventilation, and a stable temperature in the flue and stack. The flue was remodelled from a descending type to an ascending type and the corners were rounded. The flue from the boiler pipe was attached above the horizontal multipipe flue in order to avoid smoke turbulence and gas pressure. Refractory bricks closed one of the flues from the horizontal multipipes which were not in use. In order to improve combustion and to keep the temperature stable at approximately 700 C, refractory bricks were used to line the flue. The conductive surface was reduced by the use of bricks, but the combustion condition was improved. At the entrance of the stack, a dust receptacle was installed under the flue. Acid smuts were sucessfully eliminated after the improvement. The total cost for remodelling was approximately $900.

33738

Yamada, T., S. Sakabe, M. Kawai, S. Hirasawa, K. Miyajima, and M. Oya

STUDIES ON NO2 CONTROL TECHNIQUE OF STABILIZED COMBUSTION SYSTEM. (Kotei nensho sochi kara no NO2 boshi gijutsu ni kansuru kenkyu). Text in Japanese. Preprint, the Japan Society of Chemical Engineers, Tokyo, p. 75-76, 1971. 3 refs. (Presented at the Japan Society of Chemical Engineers, Autumn Conference, 5th, Osaka, Japan, Oct. 1971.)

Influences of oxygen partial pressure, combustion temperature, boiler load, and amount of nitrogen in fuel on the nitrogen oxide emission volume, were examined. A continuous infrared gas analyzer, and the naphtyl ethylenediamine method of gas analysis were used to measure NOx, and a magnetic oxygen meter was used to measure 02. The nitrogen dioxide was sampled by the wet method when gas analyzer index figure and temperature were stabilized. The NOx content and the combustion temperature formed a proportionate relationship, NOx content between 1550-1850 K temperature was 250-390 ppm. The NOx concentration seemed to decrease when the partial pressure was increased, because the combustion temperature dropped; but under a stabilized temperature, NOx concentration tended to increase when 02 partial pressure was increased. When the boiler load was reduced by half, combustion was irregular and fluctuation in NOx measurements occurred. But when the lead was three times larger, NOx content tended to increase. When the N content ratio was increased in the fuel, NOx in emission gas tended to increase; however, the ratio was not proportionate. It was concluded that the NOx content in emission gas was largely influenced by the temperature factors.

34025

Barron, A. V., Jr.

PARTICULATE AND SO2 CONTROL TECHNOLOGY FOR THE SMALL AND MEDIUM COAL-FIRED BOILER. Combustion, 43(4):44-56, Oct. 1971. (Presented at the Industrial Conference, Lafayette, Ind., Oct. 7-8, 1970.)

In firing one ton of coal with two percent sulfur, some 40 pounds of sulfur is burned and released into the flue gas. This 40 pounds of sulfur combines with oxygen to form 80 pounds of sulfur dioxide. The sulfur oxides react with moisture resulting in sulfuric acid, eventually making some 125 pounds of sulfuric acid. The particulates include fly ash, which is the unburnable inert material in fuels; soot, which is the burnable unburned material left from inefficient combustion; and lead, unburnable additive in gasoline. Electrostatic precipitators, bag or fabric collectors, mechanical dust collectors or multiple cyclones, scrubbers or washers, and thermal or catalytic converters are discussed for use in air pollution control. Design criteria are presented, as well as advantages and disadvantages. An SO2 scrubbing system project built to operate as a mobile pilot plant, unique in the Zurn designed particulate-SO2 removal system for the City is discussed. The scrubbing slurry will be a combination of sea water and pulverized native coral marl.

34026

Plumley, A. L.

FOSSIL FUEL AND THE ENVIRONMENT – PRESENT SYSTEMS AND THEIR EMISSIONS. Combustion, 43(4):36-43, Oct. 1971. 21 refs. (Presented at the Energy, Environment and Educational Symposium, Tucson, Ariz., April 5-7, 1971.)

The combustion of fossil fuels in stationary sources accounts for an annual emission of about nine million tons of particulate matter, over 24 million tons of sulfur oxide, and 10 million tons of nitrogen oxides. Efforts to reduce emissions of sulfur oxides are prompted by their damaging effects on plant life and possible adverse health effects. From the equipment operator s standpoint, sulfur oxides can be detrimental since they contribute to corrosion and deposit problems in the boiler. Techniques have been developed for control of sulfur trioxide by means of low-excess air and/or additives. Sulfur dioxide control can be accomplished by use of low sulfur fuel, fuel desulfurization, and removing the SO2 from the stack gas. Oxides of nitrogen are air pollutants because of their participation in the reactions leading to photochemical smog. Since the localities most subject to photochemical smog are in oil and gas burning areas, most of the work has been done on these fuels. The emission of oxides of nitrogen can be significantly reduced by use of a suitable firing method to control the time-temperature relationship, low excess air firing, or an alternate fuel. Boiler particulate emissions have been gradually reduced over the years by improvements in the combustion process. Particulate size distribution and the use of collection equipment such as settling chambers, cyclones, electrostatic precipitators, scrubbers, and fabric filters are considered. (Author summary modified)

34278

Baddams, H. W.

INDUSTRIAL COMBUSTION OF OIL FUELS. Clean Air (J. Clean Air Soc. Australia New Zealand), 5(2):31-37, May 1971. 6 refs. (Presented at the Clean Air Society, Victoria Branch, Sept. 1970.)

At present almost half of Australian primary energy consumption is supplied by petroleum products; typical property ranges for the oil fuels commonly available in Australia are given, including an average sulfur content of two to .25%. Variables affecting smoke and soot emissions from atomizing burners are discussed. Although desulfurization of fuel and/or flue gas may ultimately solve problems of sulfur oxide emissions, present costs remain excessive; the usual alternative for the small consumer at present, if a low-sulfur fuel oil is not economically available, is dispersion from high chimneys. Correct chimney design for height and for high exit gas velocities can enhance the effectiveness of such dispersion. Improved efficiency of many industrial oil-burning plants by installation of an instrument such as a carbon dioxide or excess oxygen recorder would achieve a drop in consumption of 90,000 tons of fuel oil for every one percent overall increase in combustion efficiency, representing reduced sulfur dioxide emissions by about 5000 tons. Costs would compare very favorably with fuel desulfurization costs. Control methods for acid smut formation in high efficiency boilers are discussed, and data are given on various dry absorption processes for SO2 and on system benefits with improved burner design.

34282

Oya, Masaaki

STUDIES ON CONTROL TECHNIQUES OF NOX FROM STABILIZED COMBUSTION SYSTEM. (Kotei nensho sochi kara no NOx boshi gijutsu ni kansuru kenkyu). Text in Japanese. Preprint, Industrial Public Nuisance Council, Tokyo (Japan), 7p., 1971. (Presented at the Public Nuisance Symposium, 6th, Tokyo, Japan, Oct. 20-21, 1971.)

The influences of oxygen partial pressure, combustion temperature, boiler negative load, and nitrogen content in the fuels on the nitrogen oxides content of stack gas were examined with experiments using a small heavy oil boiler. The NOx concentration in the gas was considerably smaller than the theoretical calculation figure that was obtained. The duration of gas stagnation in the furnace and the temperature distribution in the furnace seem to be the reason for this phenomenon. Within the temperatures 1550 to 1850 K, NOx concentration was 250 to 390 ppm and proportionate. When oxygen partial pressure was increased, NOx concentration decreased because of the drop of the combustion temperature; however, under the same temperature, NOx content tended to increase when O2 partial pressure was increased. NOx concentration increased when the N content in fuel was increased;

however, the NOx increase was relatively small compared to the N content in the fuel. As control methods for NOx in the stack gas, improvement of combustion methods by low oxygen combustion, emission gas recirculation, and two-stage combustion would be effective. As chemical methods of NOx elimination, the use of methane, hydrogen, ammonia, or alkaline solution absorption, may be examined.

C. MEASUREMENT METHODS

00275

J. R. Dewhurst and C. G. Holbrook

A TEST FOR THE SOOTING PROPENSITY OF TOWN GAS. Inst. Gas Eng. J. (London) 6, (6) 387-400, June 1966.

A new test is described in which the sooting propensity of town gas may be assessed as a Sooting Number. Laboratory tests and district experience have been used to define the maximum Sooting Number that is acceptable for British appliances adjusted for G4 gas. When the appliances are adjusted for other groups, the test burner is similarly adjusted so that the same Sooting Number limit is obtained. A simple method has been developed for calculating the Sooting Number of a gas from its composition. (Authors' summary)

00403

V. Jirasek

(ON THE SULFUR BALANCE IN STEAM GENERATORS.) Prispevek k Bilanci Siry, Parnich Kotlu. Energetika (Prague) 16(4): 169-176, Apr. 1966. Czeck Text

The methodology for experimental determination of the sulfur balance in steam generators (i.e. the distribution of sulfur between the slag, fly ashes, and gaseous combustion products) is described. The sources of various errors and their magnitude, and the accuracy of the overall sulfur balance computation is discussed in detail. Measurements carried out on basic types of Czechoslovak steam generators employing diverse means of combustion are reviewed. It is deduced that with existing methods of combustion the predominant part of the sulfur leaves together with the gaseous combustion products, and constitutes the basic amount of sulfur emitted into the surrounding. In common cases, it appears that better accuracy of sulfur-emission determination can be achieved by computation from the sulfur content of the fuel and the solid combustion products than by direct measurement of sulfur dioxide contained in the gaseous combustion porducts. (Author's summary)

03201

THE RESULT OF MEASUREMENT OF SO2 AND SO3 GASES DISCHARGED FROM BOILERS. Clean Air and Heat Management (Tokyo), 15(5):12- 13, May 1966.

This paper tabulates the results of measuring SO2 and SO3 concentrations in the exhaust gas from boilers burning heavy oil and gives the pertinent conditions of the measurements.

03460

H. A. Belyea, R. W. Johns, F. W. Taylor, and W. Surh

STACK EMISSION COLLECTOR. Preprint. 1962.

Stack Emission Collectors are relatively small test devices which may be placed in a stack for a period of time and which collect (by the settling process) a sample of the relatively large sizes of particulate matter in stack emissions, the fine or light particles continuing on through the S.E.C. The particles retained in the collector are of a size and density which would fall within several stack heights of the source of the emission and the weight of the collected sample is a measure of the nuisance created by the source. As well, an estimate or approximation of the total emission (all sizes of particles) from the source can be made whenever the kind or class of the effluent or a size and density determination of the particulate matter is known.

04324

EMISSIONS OF OXIDES OF NITROGEN FROM STATIONARY SOURCES IN LOS ANGELES COUNTY (REPORT NO. 1) (A JOINT DISTRICT, FEDERAL, STATE AND INDUSTRY PROJECT). Los Angeles County Air Pollution Control District, Calif. Feb. 1960. 55 pp.

This is the first of a series of joint project reports of work and findings on the oxides of nitrogen. The need and the recognized importance of the role of oxides of nitrogen in smog formation led to a survey of available data on the emissions of NO from stationary sources. One of the objectives of this project was to determine the rate of discharge of oxides of nitrogen from each type of equipment under varying operating conditions. Various analytical procedures for the determination of oxides of nitrogen were reviewed. Sampling and analytical procedures are discussed. The phenoldisulfonic acid method was selected because of its reliability, reproducibility, and its suitability for field test- ing. Forms used for recording field data, analytical results and calculations are contained in the appendix.

04360

H. Kuhn

WHAT IS MEANT BY BOILER EFFICIENCY? ((Was versteht man unter Kesselwirkungsgrad?)) Brennstoff-Waerme-Kraft (Duesseldorf) 17(5):250-252, May 1965. Ger.

Varying results are obtained, if the boiler efficiency is determined according to the direct or indirect methods of the VDI-Regulations for Steam Generators. The deviation of the efficiency, determined according to the two equivalent methods, increases with increasing electrical capacity of the auxiliary equipment. In extreme cases, the results by indirect measurements of the boiler efficiency are one point lower than if measured by the direct method. 0n order to achieve the same values by application of both methods, it is suggested that the DIN 1942 regulations for steam generators be corrected.

05552

B. R. Meland

A COMPARATIVE STUDY OF PARTICULATE LOADING IN PLUMES USING MUL- TIPLE SAMPLING DEVICES. J. Air Pollution Control Assoc., 18(8):529-533, August 1968. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio June 11-16, 1967, Paper 67-55.)

Particle size distributions and particulate concentrations must be known to relate effluents to reduction in visibility. Similar types of emissions from an aluminum and brass scrap smelter, a glass fiber plant, a secondary aluminum smelter, and a residual oil heated apartment complex were measured during fumigating conditions with cascade impactor, membrane filter, and rotorod samplers. The different particle size distributions and concen- trations are reported. Membrane filter or cascade impactor samples yield similar results for particulate size distributions in plumes. If unusually high loadings exist in the plume, short sampling times and separational methods of sampling such as the cascade impactor are recommended. Because of its overall high efficiency, the membrane filter is the method of choice for de- termining particle concentrations. The rotorod sampler is more capable of picking up the large particles, such as the large stringy glass fiber particles, compared to the cascade impactor or membrane filter. To get sizes and identity of larger particles, the rotorod sampler is recommended. Estimation of larger parti- cle concentrations in plumes is useful for emission inventory and contamination information in the immediate areas of the emission source.

06770

J. Tolle

(INVESTIGATIONS OF PHOTOELECTRIC DUST MEASURING DEVICES FOR MONITORING THE AIRBORNE DUST EMISSION OF STEAM BOILER FURNACES.) Untersuchungen von Lichtelektrischen Staubmessgeraten zur Uberwachung der Flugstaubemission von Dampfkesselfeuerungsanlagen. Kontinuierliche Messung der Staub- und Gas-Emission (Essen) (71) 5-23, Nov. 1965. Ger.

The theory and the statistical evaluations of dust measurements are presented which were performed by means of a two - beam photometer at a steam boiler furnace. In the theoretical part it is shown that the extinction of light is a linear function of the specific dust content, with slopes depending on the particle size distributions. The photometer uses two light beams, chopped at different frequencies, one of which crosses the chimney twice while the other acts as a reference. Both beams are detected by the same photoelement and the output signal is frequency selectively amplified. The logarithm of the ratio of the two amplitudes is proportional to the light extinction. The photometer was calibrated with the aid of a Babcock dust measuring apparatus. By varying the load of the furnace and the setting of an electrofilter the experimental conditions could be altered. A detailed discussion of the statistics of the results, such as confidence levels and error margins, is included.

07848

Short, W.

MEASUREMENT OF GRIT AND DUST EMISSION. Fuel Econ, Vol. 44, p. 89-91, 1966. 5 refs.

A cyclone and filter method developed by the British Coal Utilization Research Association combining reasonable accuracy and easy portability has been used since 1958 for determining grit and dust emission. Emissions from a chimney can be calculated as the weight of grit and dust passing the sampling plane minus the weight collected by the arrestor. Results show that, in many cases, quite low emissions are obtained without grit arrestors. When high emissions are reported where no grit arrestor is fitted at the time of test, a simple arrestor of stack or scroll type with induced draught fan would reduce emission to a low and acceptable figure if a 60% collection efficiency were achieved. For oil-fired boiler plants using oil, the ash content is very low, and emissions will largely consist of carbon particles; appreciable quantities of solid particles can also be emitted if badly operated or poorly maintained. Factors that seem to influence production of fine particles are oil preheat temperature and excess air percentage.

08895

Ministry of Technology, London, England, Warren Spring Lab.

THE INVESTIGATION OF ATMOSPHERIC POLLUTION 1958-1966. (THIRTY- SECOND REPORT). London, Her Majesty's Stationery Office, 1967, 146p. 39 refs.

A broad review of emissions, abatement processes, dispersion, weather effects on pollution, the national survey of smoke and sulfur dioxide, trends in pollution, grit and dust fall, and measurement methods is presented. Research now in progress in the United Kingdom is described and the research location and project officer for each project is given.

11859

Gruber, Charles W. and Charles E. Schumann

OBJECTIVE MEASUREMENT OF SMOKE FROM COMBUSTION SOURCES. Am. Chem. Soc. Div. Fuel Chem. Preprints, 10(1):57-64, 1966. 6 refs. (Presented at the Symp. on Fossil Fuels and Environmental Pollution Joint with Div. of Water, Air, and Waste Chemistry, Pittsburgh, Pa., March 22-31, 1966.)

The suitability of the soiling index method for evaluating the source strength of smoke plumes in objective units is discussed. Satisfactory measurements were obtained in 17 field tests on nine different plants ranging from a small steel-fired tube boiler to a 225,000 lb water boiler, fired by a pulverized fuel burner. The sampler used was a Soiling Potential Sampler which is arranged to draw a variable sample of combustion gases either directly through filter tape or through a circuit which first dilutes the sample from the source. The spots are evaluated by a reflectance meter and the soiling potential is calculated in terms of Rud-ft 2/cu ft of gas sampled. The average value of soiling potentiall per cu ft of stack gas for 16 tests was 1.10 Ruds-ft 2/cu ft; the soiling potential per unit of fuel input was Rud-ft 2/lb. of coal. By expressing soiling potential values per unit of fuel lend, emissions per unit of time can be quantitatively determined by simple arithmetic calculations. Another advantage of the soiling potential method is that the summation of source strengths in the same terms as the measurement of the resulting soiling index provides a ready means for estimating the contribution of various combustion sources to the total buildup of atmospheric particles.

16952

Luxl, F. C.

SAMPLING, ANALYZING AND CONTROL OF OXYGEN IN BOILER FLUE GAS. Preprint, American Society of Mechanical Engineers, New York, 8p., 1961. 2 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, New York, Nov. 26-Dec. 1, 1961.)

Information gathered from a series of studies was used to ascertain the best approach to the solution of the problem of sample validity in large ducts, based on 792 Orsat traverse analyses in 10 different ducts at 88 different loads, firing pulverized coal, oil, and gas. Nine probes were located in equal cross sectional areas of the duct in which the tests were conducted. The average performance of the three probes each located in the center of equal duct areas gave a higher assurance of being within a given accuracy than any of the best single probes. A single probe in the center of the duct was within 0.15% (accuracy of commercial 02 analyzers) 47% of the time, whereas the average of three probes in the center in one of each of three equal areas across the duct was within 0.15% 02 82% of the time. The maximum error that can be expected with one probe located in the center of the duct is 0.7%

02. The sampling analyzing equipment employed to monitor the flue gas for 02 in large ducts comprised of several probes, steam samplers, sample averaging unit, analyzer, and recorder. The application of sampling, analyzing equipment to automatic combustion control systems is schematically outlined.

17497

Sawicki, E., R. C. Corey, A. E. Dooley, J. B. Gisclard, J. L. Monkman, R. E. Neligan, and L. A. Ripperton

TENTATIVE METHOD OF MICROANALYSIS FOR BENZO(A)PYRENE IN AIRBORNE PARTICULATES AND SOURCE EFFLUENTS. Health Lab. Sci. Suppl., 7(1) 56-59, Jan. 1970. 5 refs.

Particulates collected from the urban atmosphere are extracted with methylene chloride, then separated alongside pure benzo(a)pyrene with alumina thin-layer chromatography; the unknown and standard spots are eluted, their solutions evaporated, and the residues dissolved in concentrated sulfuric acid. Readings of standard and test spot solutions are taken at an excitation wavelength of 470 nanometers and an emission of 540 nanometers, with the spectrophotofluorimeter or with a filter fluorimeter containing a primary filter peaking at 460 nanometers. Range of analysis is 3-200 nanograms of BaP for the spectrophotofluorimetric method, and 10-300 nanograms for the filter fluorimetric method. Laboratory air must be clean, but hydrocarbons found with or near BaP in alumina chromatographic fractions do not interfere. Eleven micromethods were compared for the estimation of BaP in a composite benzene soluble fraction of airborne particulates from over 100 communities, and an average value of 870 micrograms BaP per sample grams was obtained. The spectrophotofluorimetric method yielded an average of 800 in 8 determinations, and the filter fluorimetric method, approximately 950. A straight line relation through the origin between the concentration and the fluorescence intensity is obtained for both methods, but it is advisable to run standards at the same time. Solutions should be protected from light and stored in a cold box if they cannot be analyzed until the next day.

20256

IMPROVED N C B APPARATUS FOR MEASURING FLUE GAS DUST CONCENTRATIONS. Steam Heating Eng. (London), 39(459):12-15, Feb. 1970.

Most techniques for measuring grit and dust concentrations in flue gases rely on the use of a filter to remove all or part of the burden of solids. Drawbacks include the need to continually adjust the suction on the probe in the gas stream to compensate for increased filter resistance and the need for powerful suction equipment to overcome the high pressure drop through the equipment. A new probe design overcomes these problems by dispensing with the filter and utilizing a small high-efficiency, tangential flow cyclone carried within the probe head. The probe and its associated pilot tube (for velocity profile measurements) are designed for insertion through a 50 mm hole in a stack or duct carrying flue gases. The equipment, which is suitable for use in gas temperatures up to 400 C, is primarily intended for measuring grit and dust emission from a coal-fired boiler plant. The stainless-steel sampling probe comprises an inlet nozzle from which flue gas are led to a miniature cyclone with removable hopper. Gas is drawn through the probe by a fan. The simplicity of the apparatus permits samples to be taken from a maximum number of positions without a corresponding increase in test time. Following a test, the cyclone hopper is removed, and solids surrounding the cyclone are brushed into the hopper. The material is dried at 105-110 C until all moisture has been driven off. The material is then weighed and the solids emission determined.

20317

Brand, Ernest K. Von

ANALYTICAL APPARATUS AND METHOD FOR INSTANTANEOUS RECORDING AND READING CONTAMINANTS IN FLUENT MATERIALS. (Assignee not given.) U. S. Pat. 3,495,439. 5p., Feb. 17, 1970. 5 refs. (Appl. April 6, 1966, 10 claims).

An apparatus and method are described which obtain an instantaneous and continuous reading and permanent record of contaminants in a fluid, such as solids in air. The device utilizes a filter tape which continuously moves across a predetermined flow path of the fluid to be analyzed. The contaminants are deposited on the filter tape as a permanent record. A light source is mounted in longitudinal allignment with the intersection of the path of the filter tape and the flow path of the fluid. A photocell instantaneously and continuously senses the light reflected from the filter tape at the intersection. The quantity of light sensed is proportional to the quantum of contaminant deposited on the filter tape at the intersection. (Author abstract modified)

21055

Yamada, T., K. Nakamura, T. Kawai, S. Hirasawa, and K. Miyajima

METHOD OF MEASURING SULFUR OXIDES IN FLUE GASES. I-1. SAMPLING POSITION AND METHOD OF GAS SAMPLES FOR ANALYSIS. (Haigasu chu no iosankabutsu sokutei ho. I-1. Bunsekiyo shiryo gasu no saishu ichi oyobi hoho). Text in Japanese. Netsu Kanri (Tokyo) (Heat Eng.), 22(2):5-9, Feb. 28, 1970. 2 refs.

Sulfur oxides in flue gases are generally analyzed either by a volumetric or a colorimetric method. These methods are moderately accurate but when a concentration distribution exists on the cross section of the flue through which the gases pass, or air leaks into the pipe, accurate measurements of average density cannot be expected as long as gas samples are gathered from one point. Consequently, a regulation of the conditions for sampling gases is necessary, which is also impossible because the differences in equipment and the composition of flue gases are not equal. The result of an experiment on the sampling of flue gas is shown, using a small practical boiler as the model plant. An examination was made of how the current distribution at a spot in the pipe relates to the concentration distribution of sulfur oxides as well as the disagreement of measurements in many methods of analysis. When there is no leakage, a reliable result is obtained by sampling gas from an arbitrary point. In another experiment it was shown that when L is the length from the measuring point to the point at which air leaks occur and D is the length of one side of the pipe, the density distribution through the cross section becomes uniform at the point which a distance L/D equals 1-2 from the leak. Density becomes uniform unexpectedly soon, even when air of as much as 4% of total the volume of flue gas leaks into the pipe.

21872

THE 'OPTIMOMETER' - A DEVICE FOR AUTOMATIC CONTROL OF SMOKE EMISSION. Steam Heating Eng. (London), vol. 39:30-33, March 1970.

The 'Optimometer' monitors stack conditions and automatically adjusts burner air/fuel ratio to hold smoke emission at a predetermined level. In its present form, it is suitable for use on boilers fired by a single oil burner with fd or id fan. The device is essentially a servomechanism interposed between the oil and air supply controls, the error signal required being derived from photocell equipment in the exhaust flue from the boiler. It replaces the conventional linkage between oil valve and air damper, allowing the oil/air ratio to be trimmed as required. The equipment is supplementary to conventional controls, and is designed to allow the burner/fan control system to operate conventionally in case of failure of the smoke sensing equipment. The Optimometer maintains a smoke number of 4-5 in the stack, corresponding to operation at obscuration of approximately 3% and a smoke color between Ringelmann O and 1.

22998

Pfeifer, R. J., B. Y. Cho, and O. L. Utt

MERCURY SUBSTITUTION--NUCLEONIC DETECTION INSTRUMENT FOR SULFUR DIOXIDE MEASUREMENT. ISA (Instr. Soc. Am.) Trans., 9(1):9-16, 19 1 ref. (Presented at the Instrument Society of America, Analysis Instrument Division, National Symposium 15th, May 6, 1969.)

In the future, stack gas monitors for sulfur dioxide may be require to demonstrate compliance with federal regulations, and such monitors may become integrally associated with control systems such as scrubbers. For application in power plants and heat-generation facilities, a potential stack-gas monitor must be reliable and easily maintainable, reasonably accurate and free from errors due to contaminants, and of simple construction. The Gas sampling procedure must be such that sulfur dioxide in the gas under test is not altered by sampling conditions. A sulfur dioxide measuring instrument based on a mercury substitution and nucleonic detection (MSND) technique provides these four desirable features. The instrument is characterized by a stoichiometric substitution of mercury for sulfur dioxide in a reaction cell, transfer of the mercury to a measurement cell, and measurement of the mercury by low-energy X-radiation absorption. Construction of the instrument is simple and the disposable reaction cell is charged with reagents for 10-day operation. Measurement accuracy is excellent due to the stoichiometric substitution which is unaffected by interfering substances. Since the mercury substitution occurs in an aqueous medium, the gas sample need not be freed of water vapor and particulates. Total response time, as determined by the sizes of reaction and measurement cells and fluid flow rate, is approximatel 15 min.

23351

Shigehara, R. T., W. F. Todd, and W. S. Smith

SIGNIFICANCE OF ERRORS IN STACK SAMPLING MEASUREMENTS. Preprint, Air Pollution Control Association, New York City, 27p., 1970. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-19, 1970, Paper 70-35.)

Many separate measurements are made in order to determine the average pollutant emission rate over the sampling period. For example, temperature, pressure, gas composition including moisture content, velocity heads, and metering device adjustments are all necessary in order to accurately attain isokinetic sampling conditions. The stack sampler is faced with the problem of deciding how accurately he should make these measurements, a decision which directly influences his selection of stack sampling equipment and the sampling methodology. Maximum errors in terms of individual measurements conducted in stack sampling are considered for two specific examples: velocity measurement using the pitot tube, and a sampling train utilizing a pitot tube and an orifice meter to attain isokinetic conditions. By partial differentiation of the pitot tube equation and the isokinetic sampling train equation, the relative order of magnitude of errors are determined. For the example of measuring velocity using the pitot tube, the greatest source of error is the velocity head measurement; for the isokinetic sampling train equation, the greatest sources of error are the measurements of the velocity head, moisture content of the stack gas, and the nozzle diameter of the sampling train. (Author abstract modified)

23441

Larsson, Olov

THE MEASUREMENT OF SOLIDS IN FLUE GASES. (Matning av fasta partiklar i rokgaser). Text in Swedish. VVS(J. Assoc. Heating, Ventilation, Sanit. Engrs.) (Stockholm), 60(9):509-511, Sept. 1969. 12 refs.

Investigations indicate that available particulate measuring equipment for the determination of particulates in flue gases is error-prone in the standard measurement techniques. A minimum gas velocity of 5 m/sec is necessary to get reliable values. Discrepancies are large, and single values are not representative. Test indicate that for boilers between 200-10,000 Mcal/h, the concentration of particulate matter is about 110 mg/cu m as a mean value at standard conditions and at 10% carbon dioxide without air cleaning equipment; the concentration is about 60 mg/cu m at 10% CO2 with air cleaning equipment.

23681

Barringer Research Ltd., Rexdale (Ontario)

A REPORT TO DEPARTMENT OF HEALTH, EDUCATION AND WELFARE OF OPTICAL MEASUREMENTS OF SO2 AND NO2 AIR POLLUTION USING BARRINGER CORRELATION SPECTROMETERS. NAPCA Contract PH-22-68-44, Barringer TR-69-113, 192p., Dec. 1969. 8 refs. CFSTI: PB-193485

Research on the application and evaluation of a new measurement technique based on correlation spectrometry is described wherein a portion of the desired spectrum containing rotation-vibration band structures is compared against a stored replica of the sought spectral signature contained within the spectrometer, thereby generating a real time readout of the quantity of target gas within the field of view of the instrument. Tests on boiler stacks show that the in-stack moniter can be used succeasfully for the continuous monitoring of the sulfur dioxide content of flue gases. The airborne correlation spectrometer is used to study the oxidation of nitric oxide emissions to nitrogen dioxide downwind of the stack. Field tests in southern California indicate that the concentrations of NO2 vary considerably from point to point. Aerosol scatter and optical dilution by the California smog enhance the amount of backscattered radiation returned from the upper layers of the inversion, thereby decreasing the sensitivity of the instrument. (Author summary modified)

24879

Bnukov, A. K., Ye. I. Volkova, L. A. Goykhman, and L. M. Kofman

DEVELOPMENT AND TESTING, WITH STANDARDIZED MIXTURES AND ON A VAPOR GENERATOR, OF AN INSTRUMENT FOR MEASURING SO3 IN COMBUSTION PRODUCTS. (Razrabotka, oprobovaniye na etalonnykh smesyakh i parogeneratore pribora dlya izmereniya SO3). Text in Russian. Izv. Akad. Nauk SSSR, Energ. Transp., 5:142-146, Sept., Oct. 1969. 2 refs.

An instrument, utilizing selective condensation at about 80 C in a thermostated coil and designed to determine SO3 concentration in flue gases, was tested. Condensation droplets are trapped on a glass filter and the coil is eluted after each sampling. The quantity of sulfuric acid thus collected is then determined by titrimety, analysis requiring 3 min. Testing with standardized gas mixtures generated by controlled combustion of methane showed good convergence of the results. Use of the instrument on a boiler showed a clear relationship between air excess and SO3 concentration. Instrument operation is reliable and only simple maintenance is required.

25260

Smith, Nelson S., Jr. and George E. Fasching

ELECTROGASDYNAMIC APPLICATION TO DUST MONITORING. Preprint, International Union of Air Pollution Prevention Associations, 17p., 1970. 18 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper CP-19E.)

Electrogasdynamic principles were investigated at the basis for a continuous monitor for size and mass flow of dust in a stream of gas. A cylindrical monitor was developed consisting of a high- velocity ionizing section that electrically charges the dust, a velocity-reducing diffusing section, and a metal charge-collecting section that is segmented to permit the measurement of four currents. For dusts of uniform size, segment currents were shown theoretically to be a function of dust size and concentration. Segment currents produced by different particle sizes interact, however, making the relationship invalid. To overcome this, equations for segments currents in terms of size and flow rate of fly ash were developed from an 18-test factorial experiment coverin mean dust sizes of 43, 104, and 143 micron and dust rates of 2, 8, and 14g/hr. At the test gas flow rate of 3.5 scfm, dust concentrations were 0.15, 0.59, and 1.03 gr/cu ft. Dust sizes and flow rates predicted from the equations were subsequently compared with segment currents for known sizes and flow rates of dust within the calibration range. Largest errors in sizes and flow rate for five tests were 20 and 85%, respectively. Further reduction in error and adaptation of the method to a practical system useful in air pollution control appears feasible. The method might be used to continuously measure fly ash in power plant stack gases and, if made portable, to monitor respirable dust levels in coal mines. (Author abstract)

25593

Gilbert T.

PROTECTION OF ENVIRONMENT. (Nachbarschutz). Text in German. Rheinisch-Westfaelischer Technischer Ueberwachungs-verein e. V. Jahresbericht, 1969:57-66. 16 refs.

Methods and results of several hundred ambient concentration and emission determinations of sulfur dioxide, fluorine, chlorine, ammonia, carbon monoxide, hydrogen sulfide, nitrogen oxides and of hydrocarbons emitted by a variety of industrial enterprises and shops undertaken in 1969 in the State of Nordrhein-Westfalen are tabulated and analyzed as are 469 expert opinions concerning pollution rendered as part of a certification procedure of new enterprises from all industrial fields. Procedural and instrumental changes designed to improve on present practices as they result from the analysis are proposed. These involve emission measurement of boiler plants, dust emission by large boiler furnaces, the operation of refuse incinerators, the supervision of steam and hot water boiler plants, exhaust gases from combustion engines and errors in pollution measuring instruments (Diesel-engin smoke). Noise pollution measurements issuing from 65 different sources undertaken during 1969 are tabulated and recommendations designed to reduce the noise level are submitted. Decrees, norms and guidelines concerning pollution promulgated during 1969 in the state of Nordrhein-Westfalen are listed.

26588

DISCUSSION ON: 'A WATER COOLED SMOKE METER FOR THE ESTIMATION OF SOOT CONCENTRATIONS IN NATURAL GAS FLAMES, 'AUTOMATIC CONTINUOUS MEASUREMENT OF SULPHUR TRIOXIDE IN FLUE GASES,' 'A RAPID, MULTIPOINT, OXYGEN ANALYZER FOR POWER STATION FLUE GASES.' J. Inst. Fuel (London), 43(359):531-535, Dec. 1970. 2 refs.

The state of the art of instrumentation as related to boiler measurements is surveyed. Specifically discussed are a water-cooled smoke meter for estimating soot concentrations in natural gas flames, an automatic continuous sulfur trioxide analyzer, and a rapid, multipoint oxygen analyzer for power station flue gases. The possibility of converting the oxygen analyzer for use on residual oil-fired burners is noted; boiler conditions, especially stratification of boiler gases, influencing the accuracy of the other instruments are summarized.

26601

Shaw, J. T.

OXIDES OF NITROGEN: THEIR OCCURRENCE AND MEASUREMENT IN FLUE GAS FROM LARGE COAL-FIRED BOILERS. BCURA (Brit. Coal Util. Res. Ass. Monthly Bull., 34(10):252-259, Oct. 1970. 22 refs.

Following a discussion of the formation and decomposition of nitrogen oxides at five flue gas temperatures and a summary of nitrogen oxide emissions from four types of pulverized coal-fired burners, the state of the art of sampling and analytical methods is reviewed. The recommendation is made to sample flue gas at the lowest possible temperature by using water injection at the mouth of the sampling probe. Materials that should not be used in sampling lines are noted. Among methods for determining nitric oxide, there is little doubt that chemiluminescence will soon be applied to flue gas. By use of an oxidizer, the following methods can be applied to the determination of NO if NO2 is absent or to that of nitrogen oxides if NO2 is present: nondispersive absorptio spectrometry, electrochemical methods, and automated wet chemical methods. The ion-specific electrode method could be used to monitor the nitrogen oxides dissolved in water from a water-injecte sample probe. Manual colorimetric methods are laborious and need considerable skill.

27100

Berger, A. W., J. N. Driscoll, and P. Morgenstern

REVIEW AND STATISTICAL ANALYSIS OF STACK SAMPLING PROCEDURES FOR THE SULFUR AND NITROGEN OXIDES IN FOSSIL FUEL COMBUSTION. Prepri Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1970. 44 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-33.)

A brief review is given of the state-of-the-art in 'manual' chemica methods for stack sampling and analysis for the oxides of sulfur an nitrogen. The precision and accuracy of analytical procedures and of sampling and collection methods are compared. These results are based upon a statisitcal analysis of the sparse published field data as well as upon a significant number of unpublished power plan measurements. The observed precision (coefficient of variation) in field measurement of sulfur trioxide by absorption in 80% isopropanol is plus or minus 10-20% at 15 ppm. The controlled condensation method provides considerable improvement; precision of plus or minus 4% has been obtained for field sampling at 12 ppm SO3 Collection of sulfur dioxide in hydrogen peroxide, followed by analysis specific for sulfate provides the best precision; better than plus or minus 3% can be attained at SO2 concentrations of approximately 1000 ppm. Methods which utilize caustic or iodine collection are subject to interferences which lead to poorer precision. Regression analysis of field data for determination of NOx by the phenol-disulfonic acid method over a wide concentration range at a number of coal-fired power plants, suggests that a precision of plus or minus 3% is achieved at 1000 ppm. The precision at 100 ppm NOx. estimated as plus or minus 16%, is significantly poorer. (Author abstract modified)

27735

McKee, Herbert C.

INSTRUMENTAL METHOD SUBSTITUTES FOR VISUAL ESTIMATION OF EQUIVALENT OPACITY. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1970. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-84.)

A method developed by the Texas Air Control Board as an alternative to the 'equivalent opacity' concept utilizes an instrument to measure the optical properties of an emission in order to determine compliance with regulations. A commercial light-scattering instrument is installed in a duct or stack where the optical properties of the gas stream can be measured prior to leaving the stack, thus obtaining a continuous record of optical transmittance. The regulation provides that the light source emit spectral energy approximately equivalent to normal daylight, with no more than 10% of the total energy in the region of the spectrum above two micron wave length. A calibration procedure developed to permit use of the method as a legal basis for regulation and control is described, and precautions and an illustrative example are given. The instrumental method has several advantages over visual observations by inspectors: it is completely objective, has superior accuracy and reproducibility, can be used at all times independent of sunlight, cloud cover, darkness, or poor weather; produces continuous automatic records at far lower costs than those for frequent visual observations; and can be used as a means of process control for continuous processes. Consideration is being given to making the instrumental method mandatory for all industries subject to regulation on the basis of opacity excluding only those below some minimum size.

28708

Thoen, Gerhardt N.

GAS SAMPLING PROBE. (Weyerhaeuser Co., Tacoma, Wash.) U. S. Pat. 3,559,491. 3 p., Feb. 2, 1971. 7 refs. (Appl. March 10, 1969, 10 claims).

A probe is disclosed for sampling particulate and moisture-laden gases, especially those from combustion furnaces such as black liquor recovery furnaces, power boilers, and lime kilns. The probe is much simpler than known gas sampling apparatus, has fewer parts, and is capable of operating efficiently over extended periods of time. The probe comprises a tubular shield having an open end in the gas flow path and a tubular sampling probe mounted concentrically within the shield. The probe is made of low heat conductive subtance permeable to moisture. Particularly useful are ceramic materials. The probe allows moisture to evaporate through it to the atmosphere, cools the gas sample without degradation of its contents, and is corrosion resistant. Particulate matter which deposits in the probe is removed periodically by flushing the tubular probe with compressed air or other fluid. Valve means periodically and selectively connect the flushing fluid to the probe. (Author abstract modified)

28991

Reigel, Stanley A. and Charles W. Gruber

SOILING POTENTIAL--A PROMISING TECHNIQUE FOR EVALUATING PLUMES FROM FOSSIL FUEL COMBUSTION. J. Air Pollution Control Assoc., 21(4):214-217, April 1971. 7 refs.

The 'Soiling Potential' technique for evaluating fossil fuel combustion plumes in quantitative units is explained by examples and test results. This technique is based on measuring the light reflected by solids and expressed the soiling potential in terms of the Rud (Reflectance unit of dirt) unit, which is defined as tha quantity of light scattering solids producing an optical density of 0.01 when measured by light reflectance. The method involves passing diluted combustion gas through a tape filter and measuring the deposited spots by means of a photo-reflectance meter. The soiling potential of the emission is calculated in terms of Rud-sq ft/cu ft of stack gas, Rud-sq ft/lb fuel, and Rud-sq ft/Btu input. The technique may serve as a valuable tool in emission inventory programs since it is a reproducible method for assessing the degradation of the soiling index of the ambient air resulting from fossil-fuel combustion.

29072

Pilat, Michael, J., David S. Ensor, and John C. Bosch

SOURCE TEST CASCADE IMPACTOR. Atmos. Environ., 4(6):671-679, Nov. 1970. 24 refs.

A description is given of a source test cascade impactor for measuring the size distribution of particles in stacks and ducts at air pollutant emission sources. The impactor is operated inside the stack or duct to achieve true isokinetic sampling with a minimum of wall losses and condensation problems. The impactor includes seven stages (a single inlet jet stage, six multi-jet stages) followed by a filter. The single jet of the inlet nozzle (first stage) eliminates the problem of particle loss on the top of the first multi-jet stage. One eighth in. high rims around the parameter of the plates prevent particles from falling to the wall. The source test impactor has been used to measure the size distribution of particles emitted by a coal-fired power boiler, a kraft pulp mill recovery furnace, and a plywood veneer drier. Particle size distributions measured at the power plant and kraft recovery furnace are presented.

29313

Archer, J. S.

ON-LINE ANALYSIS OF WET COMBUSTION GASES BY GAS CHROMATOGRAPHY. J. Inst. Fuel (London), 43(349):56-58, Feb. 1970. 7 refs.

A technique is presented for the on-line analysis by gas chromatography of a single sample of wet combustion gas containing the following: carbon dioxide, carbon monoxide, hydrogen water, oxygen, nitrogen, methane, ethylene, and ethane. This analysis is not usually attempted with a wet gas or with a single sample. A hot-wire detector is used to detect components, which are separated on a dual column system. The columns used are 4-m Poropak Q and 2-m Molecular Sieve 5A at a helium carrier gas flow rate of 0.688 cu cm/s. A switching valve is incorporated to divert the sample beneath the columns. This technique was successfully used to analyze combustion gases withdrawn isokinetically from a residual fuel oil-fired combustion system. (Author abstract modified)

29677

Yanagisawa, Saburo

JIS ANALYTICAL PROCESS FOR NITROGEN OXIDES IN WASTE GAS. (JIS hai gasuchu chisso sankabutsu bunsekiho to sono mondaiten). Text in Japanese. Preprint, Japan Society of Analytical Chemistry, Tokyo, 2p., 1971. (Presented at the Nitrogen Oxides Conference, 3rd, Tokyo, Japan, Jan. 22, 1971.)

The generation and elimination of nitric oxide and nitrogen dioxide and the analytical process for nitrogen oxides - the JIS ethylene diamine method are disucssed. One third of NOx are from automobile exhaust fumes and the rest are from industrial sources. An improvement of the combustion mechanism (boiler design or motor engine change) can prevent this generation. Nitric oxide converted into carbon monoxide and nitrogen gas with the existence of hydrocarbons, and the CO is then oxidized to carbon dioxide. Several reactions are used for the elimination of NO: ammonium nitrate and ammonium chloride are formed with the addition of chloride and ammonium; lead nitrate can be produced by lead dioxide sodium chloride and sodium hydroxide form sodium nitrate and sodium chloride; the oxidation of NO makes oxygen and NO2; nitrogen dioxid can be formed with the existence of silver permangante; and cuprous oxide and manganese oxides help to make NO2. N(1-naphthyl) ethylene diamine hydrochloride, or N ethylene diamine, together wit sulfanilic acid or sulfanilamide, is used as a reagent for the JIS ethylene diamine method to determine nitrogen oxides. Ammonia water or NaOH is used as the absorption liquid; in the former case, NO2 and ammonium hydroxide produce NH4NO3 and, NH4NO2, and NO and NH4OH form NH4NO2 and nitrogen gas; for the latter case, NO2 and NaOH make NaNO3 and NaNO2. Gas is sampled with a syringe, and a swift determination of coexistent NO and NO2 must be made. Other oxidation methods for NO are air oxidation, permanganic acid method and chromic acid method. The Saltzman coefficient is important in coloring by NO2 absorption. Colorimetry and nondispersive infrared or ultraviolet absorption are applied to the continuous analysis.

29749

Bahlo, K.

DETERMINATION OF THE SOOT INDEX IN WASTE GASES OF OIL BURNERS. (Bestimmung der Russzahl in Abgasen von Oelfeuerungen). Text in German. Sanit. Heizungstech., 36(1):3, Jan. 1971.

The soot index per German norm DIN 51402 serves for the qualitative characterization of the soot contained in waste gases from oil burners. It is sometimes also called Bacharach index, based on a reference scale first developed in the U.S.A. by the laboratories of the Shell Oil Co. in co-operation with the Bacharach Industrial Instrument Co., and publicized under the name Shell Bacharach Smoke Scale. The soot index refers to the degree of blackening on a white filter paper, caused by solid particles emanating from combustion. To determine the soot index grade, a certain volume of the waste gas is aspirated by a pump whose characteristics have to conform to DIN 51402, and whose inlet connection is fitted with a filter paper. The ensuing blackening of the filter is visually compared with a soot reference scale which consists of 10 areas of various degrees of blackness. In connection with a number of oil fired heating devices, special DIN norms are in existence which als specify admissible maximum soot index values. Among these devices are atomizing and vaporizing types of oil burners, oil stoves, and oil fired boilers for hot water heating, central heating, and air heating, respectively.

29955

Bernert, Juergen

EMISSION MONITORING WITH ACKNOWLEDGED MEASURING UNITS AND ANALYZERS. (Emissionsueberwachung mit anerkannten Mess-und Analysengeraeten). Text in German. Wasser Luft Betrieb, 15(4):123-127, 1971. 13 refs.

The Ministry of the Interior has recognized the infrared analyzer URAS and the conductivity analyzer Mikrogas-MSK as suitable units for measuring sulfur dioxide emissions from hard coal- and oil-fired furnaces, as well as the smoke density measuring units RM 3g and D-R/110 for measurements of the dust content and the smoke density of waste gas. The URAS analyzer is calibrated in percent by volume. Its indication is dependent on the pressure and the temperature of the gas; as far as possible, the influence of these parameters on the results must be avoided. According to Lambert-Beer s law, the calibration curve follows an exponential function. The URAS measures absorption by a nondispersive method. The Mikrogas unit measures changes in the electric conductivity of an electrolyte consisting of diluted hydrogen peroxide solution (2.0 ml 30% H202/l of distilled water with a conductance of less than 10 microhm/cm). The change in conductance caused by SO2 absorption is indicated directly in g SO2/cu m of waste gas. The principle of the two smoke density measuring units is also based on light extinction following Lambert-Beer s law, with the difference that the normal radiation range is used ans that light extinction is achieved through dimming by the dust contained in the waste gas.

30084

Butyugina, E. M. and M. D. Kazakova

DEVELOPMENT OF A METHOD FOR DETERMINING SULPHUR OXIDES IN FLUE GASES. Thermal Eng. (English translation form Russian of: Teploenergetika), 17(6):39-43, 1970. 7 refs.

To solve the problems of corrosion by sulfur dioxide and sulfur trioxide, a reliable measurement method was developed. Sulfur oxides in flue gases are reliably determined by absorption of the gases in isopropyl alcohol followed by titration with barium perchlorate, thoron being used as an indicator. This colorimetry method is suitable for lower concentrations of sulfur oxides. It s advantages include the possibility of determining the total quantity of sulfates in a slightly acidic organic medium, which eliminates the introduction of a correction for neutralization of the absorber.

30118

SOURCE SAMPLING OF ATMOSPHERIC CONTAMINANTS. Chem. in Can., 23(5):12-13, May 1971.

At a recent symposium on source sampling, it was noted that source sampling is the key to a successful and practical abatement program and that the largest growth in sales of air pollution instrumention should occur in the field of stationary source monitoring. Within this field, automatic monitoring is expected to assume an increasingly important role. Continuous monitoring is also important. Of the particulate monitors now under development, one of the most promising is based on a Beta-ray scanning of dust caught on a filter tape. In connection with stack dust measurements, the object should be to determine not merely weight concentration of dust but rather the total emission rate. This is the only logical basis for appraising an emission, since the ground level concentration is directly proportional to the rate of emission at the source. Particle size is an important variable to be considered in monitoring and removal systems.

30219

Miura, Michiaki

ANALYSIS OF STACK GAS. (Endo gasu no bunseki). Text in Japanese. In: On Environmental Pollution Measuring Instruments and Analyzers, Kanto, Japan, Japan Society of Chemical Engineering, 1970, p. 18-23. 2 refs. (Presented at the Chemical Instruments Conference, 54th, July 28, 1970.)

The continuous analysis of oxygen, sulfur dioxide, nitric oxide, and nitrogen dioxide in stack gases is discussed. The measurement of oxygen in stack gases is important for the combustion control of boilers. Low-oxygen combustion is viewed as an effective means to prevent corrosion by sulfuric acid, heat loss, and soot-blowing. This increases operational economy and prevents air pollution caused by dust dispersion. Diagrams were presented showing the relationships between excess air ratio and oxygen for various fuels, excess air ratio and sulfur trioxide, and sulfuric acid dew point and oxygen. According to the diagrams, SO3 is not formed at an excess air ratio of zero, while the dew point becomes lower with a decrease of oxygen density. Nitrogen oxides increase with a higher excess air ratio. An oxygen meter suited for this use should have three full-scale ranges, zero to one percent, zero to five percent, and zero to ten percent, and have an accuracy amounting to plus two percent of the full scale, even at the one percent range. An oxygen meter best meeting these requirements is the magnetic-type oxygen meter. For the measurement of SO2 in stack gases, an infrared ray analyzer is usually employed. The problem here is its selectivity, which is affected by about eight to ten percent water content present in the gas. The selectivity can be also affected by carbon dioxide and carbon monoxide in the gas. The use of the new positive/negative filter system has improved the selectivity, keeping the interference of 10% H2O to 50 ppm or lower, and that of 14% CO2 to 20 ppm or lower. High- temperature and low-temperature methods are discussed for the sampling of stack gas for SO2 analysis. Under the high-temperature method, the sampled gas is heated to avoid condensation of the water content and fed into the analyzer. This gives a high- accuracy measurement of SO2 but is subject to technical and practical problems in heating the sampler and the analyzer. The low-temperature method is simpler but lower in measuring accuracy since some of the SO2 dissolves in water formed by condensation. The rapid cooling method developed by MSA of U.S.A. can keep the SO2 loss to two percent or lower of the full scale. For measurement of nitrogen oxides, either infrared ray or ultraviolet ray analyzer is used. The problems of selectivity and sampling are the same as those discussed in SO2 measurement.

30997

Pfeifer, Robert J.

MEASUREMENT OF SULFUR DIOXIDE IN STACK GASES. DEMONSTRATION INSTRUMENT: DESIGN, FABRICATION, AND TEST. Industrial Nucleonic Corp., Columbus, Ohio, AEC Contract AT(30-1)-3882, 93p., May 28, 1970. 7 refs. NTIS, CFSTI: NYO-3882-2

Theoretical and experimental studies and the construction of a working model sulfur dioxide monitor for stack gases were undertaken. The stoichiometric characteristics of the mercury-substitution process were investigated and determined to be a major advantage of the measurement instrument. Reaction stoichiometry is not affected by typical interfering substances, such as fly ash and nitrogen oxides, or by water vapor. As a result, a simple sampling system in which the stack gas is unmodified can be used. Thus the sample passed through the gauge is identical with the stack gas so that high accuracy and maintainability result. A working model embodying the mercury substitution-nucleonic detection concept was designed. Tests indicated that the instrument is capable of giving reliable measurements of sulfur dioxide to 10% accuracy in the 100-5000 ppm concentration range, with a response time of 15 min. The reaction cell was designed as a discardable unit to be replaced weekly and contains an appropriate charge of mercurous chloride. Emphasis on digital circuitry in the electronic design maximized stability and reliability of the instrument. Field testing of the instrument indicated the desirability of improving the response time of the material transport system and the overall chemical system stability. Future development includes miniaturization and redesign of the reaction and measurement cells of the instrument to eliminate excessive foaming and filtration difficulties and to reduce the response time to five min or less. (Author summary modified)

31482

Axtman, Bill

UNDERSTANDING SMOKE DENSITY INDICATORS. Fuel Oil Oil Heat, 30(8): 47-48, Aug. 1971.

The advantage of smoke density indicators over visual observation is that it provides a continuous, accurate monitoring of smoke discharge and an overall indication of combustion efficiency. Basically, the system, regardless of manufacturer, consists of a light source, light sensor, and smoke density indicating instrument. The light source and light sensor are mounted on opposit sides of the breeching or stack with the light beam focused on the photocell. Combustion gases passing between the light and photocell reduce the amount of light striking the cell in proportion to the amount of smoke present in the stack gas. A micro-ammeter connected to the output side of the photocell is calibrated in such a manner that cell output current is proportional to the amount of smoke present. The Ringelmann and Shell-Bacharach smoke reading scales are mentioned.

31547

Sjogren, Arne

DETERMINATION OF CARBON CONCENTRATIONS IN FLUE GASES--PART II: FROM THE COMBUSTION OF RESIDUAL FUEL OILS. J. Inst. Fuel, vol. 44:373-376, July 1971. 7 refs.

A method and Orsat apparatus are described for the determination of the carbon concentration in flue gas when using fuel oils or distillate oils. A sampling probe is inserted in the flue gas stream and, when it has achieved an adequate temperature, the suction pump is started, and continued until sufficient carbon has been collected on the silica wool. When the sampling is finished, the filter is flushed with oxygen, and the burette, which during the sampling has been full of water, is filled with oxygen to the zero-mark. After setting the equipment to zero, the filter is heated by a gas flame. When all the carbon has been burned and the silica wool turns white, the filter tube is cooled and at the same time carbon dioxide is absorbed in the potassium hydroxide. The volume of the oxygen consumed is measured. There is a very simple relationship between oxygen consumption and the quantity of carbon collected on the filter material. It is very important to ensure that the filter and oxygen in the system are cooled to ambient temperature before setting the burette to zero.

31723

Geller, Z. I. and N. M. Ashikhmina

INFLUENCE OF ERRORS IN DETERMINATION OF CARBON BY THE YUZHORGRES METHOD ON THE ACCURACY OF CALCULATION OF FLUE GAS CARBON WITH COMBUSTION OF OIL. Thermal Eng. (English translation from Russian of: Teploenergetika), 17(1):109-113, Jan. 1970. 6 refs.

Carbon concentration was determined by burning carbon in a tubular furnace at a temperature of 700 C. The carbon dioxide formed was absorbed in bubblers filled with a solution of barium hydroxide. The absorbed amount of CO2 was determined by back titration of the residue of barium hydroxide with 0.1 normal solution of hydrochloric acid. The qualitites of this method were evaluated by comparing calculated values of systematic errors with experimental values of overall errors. The total error was calculated as the difference between the weighted carbon and that determined from back titration. In addition to systematic errors associated with the measurements, random errors could occur, leading to a result either too low to follow or too high. Maximum absolute and relative errors were determined for the method. Recommended sampling times are included.

31842

Boubel, Richard W.

A HIGH VOLUME STACK SAMPLER. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 17p., 1971. 7 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-114.)

The development, design, and trial application of a sampling train to gather a relatively large amount of particulate sample in a short period of time are discussed. The high volume train overcomes the shortcomings of other sampling trains and has some additional advantages. It uses the same glass fiber that is specified for ambient air particulate sampling, so that the emission test results are directly comparable to ambient air sampling data. No additional equipment is needed for the emission sampling analysis. The sample collected by the high volume probe may be analyzed microscopically for size and characteristics of the particles, an important factor if the control equipment is to be specified for the process or source. The high volume sampler was evaluated on field tests of wood fired boilers, incinerators, wigwam burners, asphalt batching plants, seed cleaning plants, and wood fiber filtration systems. The results obtained from a variety of sources using this probe indicate that it is both versatile and reliable, and no serious problems in its use have been encountered. (Author abstract modified)

31981

Sjogren, Arne

DETERMINATION OF CARBON CONCENTRATIONS IN FLUE GASES--PART 1: FROM THE COMBUSTION OF DISTILLATE OILS. J. Inst. Fuel, vol. 44: 370-373, July 1971. 4 refs.

A method and apparatus are described for fast and reliable determination of the carbon concentration in flue gases from the combustion of distillate fuel oil. This method is based on the principle of staining filter paper with soot, but differs from the current method for smoke number determination in that a variable volume of flue gas is drawn through the filter paper to give a fixed degree of staining (reflection). Thus, the volume of the flue gas is a measure of the soot concentration. The soot concentration is easily calculated from the known volume of gas by measuring the soot deposited on the filter paper at the chosen fixed staining. The heart of the apparatus is a measuring cell in which flue gas is drawn through the filter paper and a photocell measures the reflection calibration is also discussed. The method is currently used in an oil burner laboratory to determine the relationship between soot formation and excess air for oil firing.

32008

Driscoll, J. N., A. W. Berger, J. H. Becker, J. T. Funkhouser, and J. R. Valentine

DETERMINATION OF OXIDES OF NITROGEN IN COMBUSTION EFFLUENTS WITH A NITRATE ION SELECTIVE ELECTRODE. Preprint, Air Pollution Contr Assoc., Pittsburgh, Pa., 16p., 1971. 16 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-149.)

Nitrate ion selective electrode was investigated as an alternative approach to the present colorimetric determination of nitrate resulting from oxidative absorption of nitrogen oxides from combustion effluents. The electrode offers advantages of speed and relatively simple experimental procedure. Replicate measurements of 0.0001 to 0.01 M nitric acid solutions using bracketins standards show that the electrode approach is capable of good precision with a coefficient of variation of about 4%. Comparison of a method utilizing the nitrate electrode with the more laborious phenol disulfonic acid method for the measurement of nitrogen oxides in both oil and gas fired combustion effluents showed agreement with 4% of the mean, even in the presence of high levels of sulfur dioxide. The correlation coefficient found for phenol disulfonic acid versus nitrate electrode is 0.987. (Author abstract modified)

32773

Bailey, J. B. W., N. E. Brown, and C. V. Phillips

A METHOD FOR THE DETERMINATION OF CARBON MONOXIDE, CARBON DIOXIDE, SULPHUR DIOXIDE, CARBONYL SULPHIDE, OXYGEN AND NITROGEN IN FURNACE GAS ATMOSPHERES BY GAS CHROMATOGRAPHY. Analyst (London), 96(1143):447-451, June 1971. 15 refs.

A method is described for the routine analysis of mixtures containing carbon monoxide, carbon dioxide, carbonyl sulfide, sulfur dioxide, oxygen, and nitrogen using a dual-column system and a katharometer detector. The method was suitable for 1 ml gas samples containing from 0.07 to 100% of one of the gases, provided that the CO-CO2 or N2-CO ratios did not exceed 50:1. (Author abstract modified)

33054

Lasa, J., A. Korus, and Maria Kilarska

ANALYSIS OF SULPHUR COMPOUNDS OF INDUSTRIAL COMBUSTION GASES BY MEANS OF AN ELECTRON-CAPTURE TYPE DETECTOR. International Atomic Energy Agency, Vienna (Austria), Nucl. Environ. Pollut. Proc. Symp., Salzburg (Austria), 1970, p. 215-221. 3 refs. (Oct. 26-30, Paper IAEA-SM-142a/11.)

Sulfur compounds occurring in industrial combustion gases present a dangerous environmental pollution problem. Results of the analysis of these compounds by gas chromatography using an electron capture-type detector (a radioionization detector) are presented. The analysis of sulfur dioxide and carbon disulfide was made on a chromatographic column 70 cm long and four mm in diameter filled with Celite covered with polyethylene glycol. Hydrogen sulfide and carbonyl sulfide were separated on a column 30 cm long and three mm in diameter filled with silica gel. An electron capture-type detector with a nickel-63 source was used, with nitrogen as carrier gas in the dc or pulse modes of operation. The universal detector, which can work as well as a cross-section, argon, and electron capture-type detector, is described. (Author abstract modified)

D. AIR QUALITY MEASUREMENTS

02147

(RESULTS OF SO2 AND HO6 MEASUREMENTS WITH FLUE GAS OF OIL-FIRED BOILERS.) Clean Air and Heat Management (TOKYO) 15, (4) 26-7, APR. 1966.

Data are tabulated for ten factories indicating the extent of pollution from oil-fired boilers. Weather conditions, fuel analyses, exhaust gas analyses, types of test instruments and design of boilers and stacks are some of the data considered.

03363

M. S. Sokoloskii, Zh. L. Gabinova, B. V. Popov, L. F. Kachor, and B. S. Levine, 'Translator'

SANITARY PROTECTION OF MOSCOW ATMOSPHERIC AIR (U.S.S.R. LITERATURE ON AIR POLLUTION AND RELATED OCCUPATIONAL DISEASES, VOLUME 14). Moscow Sanitary-Epidemiological Station. 1965. 68 PP. CFSTI, TT 67-60046

Moscow is a large industrial center with various types of industries discharging a complex of solid and gaseous, organic and inorganic chemical substances into the air, causing considerable damage to the National economy. This work reviews the Moscow Sanitary Service in its efforts to control air pollution from the many sources described.

05645

A SURVEY OF HEATING AND POWER PLANTS IN ADRIAN, MICHIGAN (WITH RECOMMENDATIONS FOR THE ELIMINATION OF SMOKE). Preprint. (Coal Producers Committee for Smoke Abatement). (1951).

The results of a survey of smoke and other air pollutant sources in Adrian, Michigan are discussed. Recommendations for the abatement of smoke and an air pollution ordinance are included.

07141

Dubrovskaya, F. I.

THE EFFECT OF SMOKE EMISSION PURIFICATION ON AIR DUST CONCENTRATION OF A LARGE CITY. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 1:118-121, Jan. 1960. (Also published in Gigiena i Sanit., 23(1):69-71 1958.) Translated from Russian. CFSTI: TT 60-21049

Over a period of several years the pollution of Moscow air was studied. The accumulated data presented the opportunity to determine the changes in air pollution intensity which resulted from the introduction of control measures. One of the basic measures was an official mandatory requirement that fly ash be removed from smoke gases emitted by electric power and heating plants and by boiler operated manufacturing and production industries. A comparison of the data under study with the value representing the limit of allowable concentration of dust in the atmospheric air of inhabited localities, shows that in most of the samples studied the dust concentration exceeded the maximal single limit of allowable dust concentration of 0.5 mg/cu m. Thus, despite considerable attainment in the fight against air pollution in Moscow, the condition of the air with regard to dust concentration failed to come up to the official sanitary requirement. Data regarding dust concentrations in different sections of the city during cold and warm weather, from 1946 - 1956, are presented in graphs.

12358

Craxford, S. R. and M.-L. P. M. Weatherley

AIR POLLUTION IN GREAT BRITAIN. Centre Belge d'Etude et de Documentation des Eaux, Liege, Belgium, 17p., 1968. 2 refs. (Presented at the International Congress of the Centre Belge d'Etude et de Documentation des Eaux, 21st, Liege, Belgium, May 1968.)

Data are presented for smoke and sulfur dioxide emissions in Great Britain from 1952 to 1967. The data for smoke show a steady decrease in the amount emitted since 1954; by 1967, the values had dropped to 40% of 1954 values. The decrease is closely tied to the Clean Air Act of 1956, which prohibited the emission of dark smoke. Practically the whole of the smoke emitted during the period surveyed arose from the incomplete combustion of coal in inefficient boiler plants and furnaces. Considering the steady fall in the consumption of coal by industry and its replacement by oil, smoke emissions should decrease another 15% by 1975. Ground-level pollution is shown to be caused almost entirely by smoke from domestic heating. Despite the nation-wide decrease in smoke emissions, smoke levels are still unsatisfactory in the North where domestic provisions of the Clean Air Act have not been strictly enforced. The data for sulfur dioxide show that emissions have reached their peak and are not decreasing, despite increasing industrial activity. Continuing decreases are anticipated as North Sea gas and nuclear energy come into use. As with smoke, ground-level concentrations of sulfur dioxide are closely linked to domestic emissions.

17360

Craxford, S. R. and M.-L. P. M. Weatherley

ATMOSPHERIC POLLUTION IN GREAT BRITAIN. (La pollution atmospherique en Grande-Bretagne). Text in French. Pollut. Atmos. (Paris), no. 44:187-194, Oct.-Dec. 1969. 2 refs.

The total population, energy consumption, and emissions of black smoke and sulfur dioxide in Great Britain in the years 1952 to 1967 are given. Black smoke emission in the years 1952 to 1967 shows a continuing decrease since 1954 which is directly related to the Clean Air Act of 1956. Analogous data based on other sets of measurements carried out during some of these years are plotted. Almost all black smoke is due to incomplete combustion of fuel oil in boiler furnaces or in inefficient furnaces. The Act required that all changes of the operating equipment should be completed before 1961. Hence, the further decrease a black-smoke emission is due to progressive modernization of the equipment. Total coal consumption and black-smoke emission between 1952 and 1967 is given. The act gave municipalities the power to establish 'smoke control areas' in which the use of domestic fuels other than 'smokeless fuels' is forbidden. These areas contribute significantly to the decrease of the total black-smoke emission. Analogous information regarding SO2 emission, both total and separate according to domestic, industrial, and power plant sources is plotted. No decrease of SO2 emission occurred until 1960, but from that year on, a slow decrease has occurred to the present. The distribution of black smoke and SO2 contents in micrograms/cu m as well as in terms of gigagrams/1 million of inhabitants is given in conjunction with the map of districts of Great Britain. On the basis of the above mentioned air pollution data, forecasts are made for 1970 and 1975 which are quite optimistic.

17785

Gurinov, B. P.

CANCEROGENIC SUBSTANCES IN THE ATMOSPHERIC AIR WITH A VIEW TO CANCER PREVENTION. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:145-152, 1963. (B. S. Levine ed.) CFSTI: 63-11570

Studies on the effect of cancerogenic substances present in the atmosphere are reviewed with special reference to 3,4-benzyprene. The percent of 3,4-benzypyrene present in selected Russian cities is reported and compared with measured levels in the U. S. and England. Lower levels (100 times less) in the USSR are attributed to differences in the intensity of automobile traffic and to different air sampling methods. Comparative studies of fuel burning methods which indicate that the discharge of cancerogenic hydrocarbons could be eliminated by improved fuel combustion are summarized. Data is presented to show that the layer-bed method of hand-stoked fuel burning produces dust with a high 3,4-benzpyrene concentration, while mechanically stoked fuel produces lower concentrations; burning by the chamber method generated dust with almost no 3,4-benzpyrene. Other investigations indicate that small boiler plants emit smoke and gases containing polycyclic hydrocarbons of the type 1,12-benzoperilene and 3,4-benzpyrene, and that diesel operated engines emit less 3,4-benzpyrene than carburetor operated automobiles. No 3,4-benzpyrene has been discovered in the crude oil bitumens used to pave streets in the USSR.

29348

Nakatsuji, N., G. Ueda, and K. Sakai

ATMOSPHERIC POLLUTION FROM HEATING BOILER OF BUILDING. (Biru dambo no taiki osen ni oyobosu eikyo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):19, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

The characteristics of air pollution due to heating of buildings in Osaka were analyzed based on the distributions of sulfur oxides concentrations (lead dioxide method), the number of smoke emission sources, and amount of sulfur emissions. The observations were conducted in the summer and the winter of 1968. The density of air pollution was high in winter in the central area of the city where it is mainly commercial and residential. The cause is attributed to the boilers for the winter heating of the buildings in the area, as well as the pollutants from the coastal industrial areas, although it is not yet clear meteorologically how the industrial pollutants are transported to the center.

29973

Tokyo Metropolitan Environmental Protection Research Inst. (Japan)

POLLUTIONS AND TOKYO METROPOLITAN GOVERNMENT. (Kogai to Tokyo-to). Text in Japanese. 724p., June 1970.

Ten thousand and four hundred facilities are required to report under Air Pollution Control Law, of which 91% are boilers. In the six central wards, there are 37% of the total boilers, considered to be for heating of buildings. There are only 17 open hearths, 84 cupolas, 61 electric furnaces for steel making, 25 boilers for thermal generation, and 45 facilities to supply city gas. Of the 19 stacks taller than 70 m, 13 are in Kawasaki City, and nine are in Yokohama; these 41 stacks emit 6,783.3 cu m sulfur dioxide. Pollutants emitted in a year in Tokyo are: 857,000 tons of carbon monoxide, 444,000 tons of SO2, and 30,000 tons of particulates. This is roughly twice as much SO2 and CO as in the U. S. Metals and sulfuric acid mist adhere to dust. Also the 10 micron and submicron particulates from electric furnace can be seen only under electronic microscopes. At a busy intersection in Tokyo, 11.6 ppm CO on the ground was measured, the daily average was 11.6 ppm and 12.3 ppm at another crossing. Nitric oxide concentration in front of the Metropolitan Government Office was 0.078 ppm, annual average, but in the hinterland, the concentration of nitrogen dioxide was greater. The number of cars has increased at the rate of 100,000 a year since 1960, and at 200,000 since 1966; recently there is one car for every 6.5 people. Most of CO is estimated to have been caused by the automobiles gasoline combustion. Cars emit NO at high concentrations near the ground. Also, 270 complaints out of 1000 complaints on air pollution lodged with the Metropolitan Government in 1960 concerned the factories which generated harmful substance and obnoxious odor. Of 12,000 factories, employing more than 20 workers, about 5000 are suspected of emitting harmful gas and obnoxious odor. Since 1964, manuals on guiding these enterprises have been in use on dust, harmful substance (ammonia and chromium acid mist), and there are 14 in all as of March, 1969. Thirteen automatic measuring equipment stations have been installed to measure SO2 and micro- particulates (rate of filtering) and six stations measure CO, NO, and NO2 (to be increased to nine in the future). At present, five spots on major highways measure CO, NO, NO2, and hydrocarbons (to be increased to 10 spots in 1969 and 1970). Air pollution control agreements have been concluded between the Tokyo Metropolitan Government, the Tokyo Electric Power Co., and the Tokyo Gas Co.

30860

Murphy, R. P.

AIR POLLUTION CONTROL IN NEW SOUTH WALES. Preprint, Dept. f Public Health, Sydney (Australia), Air Pollution Control Branch, 20p., 1970 (?).

All Australian state governments, with the exception of Tasmania, have passed air pollution legislation. The federal Clean Air Act established an Advisory Committee, fees, administration, regulations setting up emission standards, and licenses. An Air Pollution Control Branch was established with 10 engineers, four chemists, two technical officers, seven field assistants, and one laboratory attendant to implement the Act, monitor pollution, and research the problem. Stacks were sampled and analyzed by chemistry, spectroscopy, chromatography, and other means. New monitors have been developed including a sulfur dioxide colorimeter and a portable gas calibration apparatus. Three Clean Air Conferences have taken place, and a Clean Air Society was formed. Air pollution was monitored in Sydney and nearby cities. Dust fall improved over the years, while smoke density and sulfur dioxide concentrations have varied. Insoluble solids ranged from four tons/sq mi/month at purely residential sites to up to 60 tons sq mi/month at industrial sites. Average daily values of SO2 and smoke density were determined by hydrogen peroxide and paper tape clamps, respectively, at a series of monitoring stations. Also, continuous SO2 monitors were installed operating on the conductivity principle, but these were unsatisfactory for low concentration measurements. Hourly smoke haze results between 1960 and 1967 showed a reduction in the frequency of smoggy days and in the maximum hourly and daily values. Automobile exhaust was monitored close to Sydney traffic lanes; carbon monoxide ranged from .2% to 10% and could be lowered by adjusting the idling speed; aldehydes (formaldehyde), nitric oxide, nitrogen dioxide, lead, hydrocarbons (as methane), and other particulates were also measured. The cost of air pollution control in New South Wales was determined by a survey of various industries. The total expenditure for five years (1963-1968) was 39,910,000. Iron and steel companies spent 34.2% of the total and electric power suppliers spent 28.2%. The cost per person per year was $1.89. Other industries included boilers, cement, metallurgical, milling, chemical, oil refining, and gas. Various factors influencing pollution dispersion were studied including inversions, seasons, topographical interactions, and so on. The effect of weather conditions on smoke in the Sydney area was studied; air pollutants emitted to the west of Sydney during inversions increased the maximum values recorded at Sydney or extended the period during which high values occurred. Various analytical instruments are listed.

32055

Murphy, R. P.

THE PROBLEM OF AIR POLLUTION. Preprint, Dept. of Public Health, Sydney (Australia), Air Pollution Control Branch, 8p., 1969.

Air pollution has now reached especially significant levels in industrial cities. Smog episodes and health studies of bronchitis, mortality, and respiratory diseases have increased the urgings for pollution legislation. Therefore, Australian state, federal, and local governments have passed control legislation. The New South Wales Clean Air Act of 1961 established an advisory committee, licenses, and fees. Certain meteorological conditions can increase air pollution to the degree that illness and death can occur. An organization of engineers, chemists, and laboratory assistants was set up to implement the Clean Air Act. Emission limits were set after chemical and dust emission tests were made in exhaust flues. The main sources of air pollution are boilers, kilns, and furnaces which produce smoke, fly ash, and sulfur dioxide. Chemical plants, metallurgical processing, grinding, and milling also produce some contaminants like metal fumes and dust. Motor vehicle exhaust and smoke from shipping contribute as well. Air pollution was automatically monitored daily in Sydney, Newcastle, Port Kembla, Lithgow and Wollongong (dust fall, smoke haze, and SO2). Continuous recorders were also used to monitor hydrogen sulfide, nitrogen oxides, total oxidants, suspended inert dust, iron, copper, and lead. In Sydney, SO2 concentrations were usually lower than that for British cities, but high values sometimes occurred. A peak value of 270 ppm was recorded in 1967 with a maximum daily average of 57 ppm. Since crude oil and naturel gas are being increasingly used, air pollution by sulfur gases should be reduced in the future. Surveys of motor vehicle exhaust showed slight oxidant content (an indicator of photochemical pollution), and some carbon monoxide, aldehydes, hydrocarbons, nitrogen oxides, suspended dust, and lead in congested traffic areas near the center of the city. The CO concentration reached a peak of 80 ppm, and the average value was 50 ppm. Adjustment of the idling speed reduced CO. Natural gas is replacing older fuels, but few Australian plants are eager to improve their existing plants and reduce pollution.

32259

Hidy, G. M., S. K. Friedlander, and W. Green

BACKGROUND INFORMATION ON SITE AND METEOROLOGICAL EXPERIMENTS. PASADENA SMOG EXPERIMENT. In: Aerosol Measurements in Los Angeles Smog, Vol. I, Section II. Minnesota Univ., Minneapolis, Particle Technology Lab., Particle Lab. Pub. 141, Air Pollution Control Office APTD-0630, PHS Grant AP-00680-02, 18p., Feb. 1971. 14 refs. NTIS: PB 198816

The general character of the observational site, an inventory of sources, and the meso-scale meteorology of the Los Angeles basin are presented. The physical site in Pasadena is described in detail and a brief summary of the meteorological instrumentation and support of the program is presented. Typical stationary sources producing a variety of pollutants include chemical processing equipment, boilers and heaters, paint bake ovens, incinerating equipment, melting equipment, and power plants. The power plants release mainly nitrogen oxides to the atmosphere. Typical contaminant concentration levels are listed for the summer months in West San Gabriel Valley. The broad scale features that characterize Los Angeles weather are the Pacific high pressure zone which dominates the synoptic scale atmospheric motion from early spring to early fall, the continental high pressure region over the deserts and high plains to the east and north which is present most of the period from fall through winter, and the winter passage of cyclonic storms originating to the north, south, and west over the Pacific. In addition to direct observations made from the roof of Keck Laboratories, several parameters were recorded from local sources. Some meteorological charts and data on emissions and meteorological instrumentation are included.

E. ATMOSPHERIC INTERACTION

15174

Inouye, Rikita

ON THE TEMPERATURE RISE OVER CITY CENTERS. (Toshi chushin chiiki ni okeru kion no josho gensho ni tsuite). Text in Japanese. Eisei Kogaku (J. Hyg. Chem.), no. 9:1-11, Jan. 1964. 8 refs.

The phenomenon of higher air temperatures over city centers as compared to the temperature over the suburbs is explained in many cases by the greenhouse effect. The air conditions of typical cities of Japan, such as Tokyo, Osaka, Sapporo, and Asahigawa, were analyzed. Sapporo and Asahigawa have a different type of air temperature rise from Tokyo and Osaka. From the estimate of the heat balance of Sapporo, it was concluded that the rise in temperature was not due to the greenhouse effect but to the lessened exposure to sunshine because of polluted air, and to the heat from city boilers and stoves. (Author abstract modified)

20853

Perkins, R. W., C. W. Thomas, and J. A. Young

APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES. J. Geophys. Res., 75(15): 3076-3087, May 20, 1970. 11 refs.

Measurements of cosmogenic radionuclides Cl(38), Cl(39), and Na(24) in consecutive rain water samples during storms have provided a basis for studying precipitation formation. These radionuclides, which result from cosmic ray spallation of atmospheric argon, 'label' the natural aerosols, and can thus serve as tracers of in-cloud scavenging. They are collected on cation and anion resin beds and are counted on multidimensional gamma ray spectrometers. Cloud droplets form on 'labeled' condensation nuclei. During subsequent growth of the cloud droplets through coalescence and condensation, additional collection of newly formed cosmogenic radionuclides appears to be small. During their in-cloud development, the raindrops may be subjected to several cycles of partial evaporation followed by further coalescence and condensation, particularly in light rains. Measurements indicate that light rains have spent a substantially longer period in their development than heavy rains. They show higher radionuclide concentrations and higher ratios of long-lived to short-lived radionuclide.

26550

Short, W.

POLLUTION PROBLEMS FROM COMBUSTION PROCESSES. Environ. Health, 78(11):510-517, 550, Nov. 1970. 35 refs.

The essential problems with the combustion of any fuel or waste material include the nuisance due to dust, smell or particles while awaiting incineration, smoke due to poor combustion, grit and dust emission from the chimney, emission of toxic or offensive gases fro the chimney, and disposal of the residue which may contain offensiv or dangerous material. Smoke formation, furnace residues, and the storing of fuels are mentioned. Recommended chimney heights and plume behavior are also discussed. When calculating maximum concentrations of solids and sulfur dioxide, the formula used is fo an instantaneous value as might be obtained over a short period of say 3 minutes when all variables, especially wind speed and direction, are fixed at constant values. While the Clean Air Act does not lay down any figures for permissible dust and grit content in the flue gases leaving the chimneys of a boiler plant, various organizations have made suggestions covering a range of about 0.2 t 0.3 grains per cu ft of gases. However, the size distribution is important. Grit and dust deposition and measurement are discussed, and it is suggested to state the emission as weight emitted in an hour, rather than just weight and volume. Sutton's diffusion equation is cited, while factors affecting a thermal plume include the temperature of gases, their velocity and mass, and the stack height. The incineration of chlorinated compounds and some special wastes, such as organic tars, is also mentioned.

28937

Nonhebel, G.

HEIGHTS OF CHIMNEYS. In: Gas Purification Processes. G. Nonhebel (ed.), London, George Newnes Ltd., 1964, Chapt. 19, p. 824-880. 66 refs.

New knowledge on chimney design to ensure adequate dispersal of chimney gases and general rules to be followed are summarized. Power station chimneys should be at least 2.5 times the height of adjacent buildings to overcome the effects of downdraught and as slender as possible to avoid downwash. The formula for calculating the height necessary to overcome the effect of downdraught is given. A minimum height of 120 ft for emissions from chemical processes is suggested. Recommended heights for smal industrial boiler plants with relatively innocuous effluents are tabulated. The discharge velocity should be 50-60 ft/sec. Acceptable ground-level concentrations of gases derived from chimney discharges are discussed in terms of effects on human beings, farmstock, and vegetation. Methods are given for calculating the concentration which reaches the ground from a chimney by the process of eddy diffusion and for rate of dust deposition. The daily rate of coverage of surfaces by deposited dust should not exceed 0.04%. Formulas for calculation of gas concentrations downwind of a chimney and examples of the two steps of calculation (the maximum height of plume rise and downwind concentration) are given. Two equations and an example for determining the distance from the chimney at which the plume becomes substantially invisible are included.

29177

Yoshida, Tsuyoshi

THE DIURNAL VARIATION OF THE POLLUTANT CONCENTRATION IN AN URBAN AREA. (Toshinbu ni okeru taiki osen nodo no nichikenka ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):113, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

Air pollution in Sapporo in winter shows morning and evening concentration peaks. The vertical diffusion coefficient was calculated from the daily variation of the temperature and from boundary conditions at the upper layer. Together with the emission intensity obtained from a boiler investigation, an attempt was made to solve by approximation the diffusion equation. Two-peaked high concentrations were reproduced. The technique essentially involves a set of simultaneous second-order partial differential equations relating wind speed to the vertical distance and temperature gradient to the vertical distance, respectively. Two parameters are involved: KM, the vortex diffusion coefficient of the momentum, and KH, the vortex diffusion coefficient of heat. By approximation methods, KM, which is a function of height and time, is used to approximate the vertical diffusion coefficient KZ. The solution by the relaxation method of the second-order partial differential equation gives the concentration as a function of time and vertical distance, after a proper set of boundary conditions has been chosen.

31122

Yoshida, Tsuyoshi

THE DIURNAL VARIATION OF THE POLLUTANT CONCENTRATION IN AN URBAN AREA. (Toshinbu nokeru taiki osen nodo no hihenka nitsuite). Text in Japanese. Kuki Seijo (Clean Air J. Japan Air Cleaning Assoc., Tokyo), 9(1):35-44, April 1971. 10 refs.

From the record of pollutant concentrations in the urban area it can be seen that the concentration increases after sunrise and sunset and decreases in the daytime. The concentration peak after sunrise is attributed to the warming up of heating boilers in early morning. The factors responsible for the increase after sunset are not known. Numerical experiments are proposed, which use the Fickian diffusion equation connected with the diurnal variation of the eddy diffusion coefficient, Kz. The diffusion coefficient also depends on the diurnal variation of the lower atmospheric temperature. The decrease in concentration during the day can be seen in the results. The concentration peak after sunset, which occurs with a decrease in emission rates, is explained by the fact that Kz becomes smaller than the daytime value and the atmosphere loses its diffusion ability. (Author summary modified)

32371

Council of Ministers (USSR), Voeykov Main Administration and Inst. for Industrial Buildings and Construction (USSR) Central Scientific Research and Experimental Project

RECOMMENDATIONS FOR THE CALCULATION OF DISPERSION IN THE ATMOSPHERE OF NOXIOUS AGENTS (DUST AND SULPHUR DIOXIDE), CONTAINED IN THE EFFLUENTS FROM INDUSTRIAL UNDERTAKINGS. Gidrometeorolog. Izdat., 1967. Translated from Russian. National Lending Library for Science and Technology (England), 49p.

A procedure for calculating dispersion in the atmosphere of dust and sulfur dioxide discharged by industrial installations and boiler plants is presented. Meteorological coefficients, ground level emissions, maximum allowable concentrations, the gas-air mixture in the flue gases, and topographic characteristics are examined. Single sources and groups of emission sources are considered and recommendations are given for calculating the background pollution of the air basin of a residential area and determining the boundaries of the health protection zone. Proposals for basic measures for protecting the air basin from pollution with the operation of industrial installations and boiler plants are presented. (Author abstract modified)

F. BASIC SCIENCE AND TECHNOLOGY

00572

A. B. Hedley, T. D. Brown, and A. Shuttleworth

AVAILABLE MECHANISMS FOR DEPOSITION FROM A COMBUSTION GAS STREAM. American Society of Mechanical Engineers, New York. (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, Chicago, Ill., Nov. 7-11, 1965, Paper No. 65-WA/CD-4.)

The paper describes various mechanisms by which mineral impurities in combustion gases, present either as a vapor or as discrete liquid or solid particles, can find their way onto cooled surfaces in the path of the gases. It is shown that impaction of large particles and vapor diffusion are the dominant deposition mechanisms. Diffusion of particles is unlikely to be of importance except as a rate controlling step in the vapor diffusion process. This will occur only when a vapor condenses within the temperature boundary layer thus producing particles. The importance of the various mechanisms in practical systems such as boilers and gas turbines is assessed. (Author)

03874

A. Levy E. L. Merryman

INTERACTIONS IN SULPHUR OXIDE-IRON OXIDE SYSTEMS. J. Eng. Power 89 A(2), 297-303 (Apr. 1967). (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 28-Dec. 1, 1966.)

The aim was to examine what is occuring during passage over the boiler tubes where catalytic and chemical reactions can occur on and with the iron oxide surfaces. Fe2O3-, Fe3O4-, and Na0H- Fe2O3-, and Na0H-Fe3O4-coated substrates of Vycor and of iron were exposed to controlled gas mixtures containing SO2 and SO3. Sulfate and sulfide formation is examined and explained on thermodynamic grounds. Examinations of the role of MgO coating indicates a limited 'protective' effect through its removal of SO3 from the gas stream.

03881

W. T. Reid

BASIC PROBLEMS IN THE FORMATION OF SULFATES IN BOILER FURNACES. J. Eng. Power 89, 283-7 (Apr. 1967). (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 27-Dec. 1, 1966.)

Reactions involving the formation of sulfates are responsible for most of the problems with external corrosion in boiler furnaces. This paper reviews what is known today about these materials and how they are formed in combustion systems. (Author's abstract)

04357

S. Dauer

(COMBUSTION TRAINGLE FOR FLUE GASES FROM COMPOUND FURNACES.) Das Verbrennungsdreieck fur Rauchgase aus Mischfeuerungen. Brennstoff-Waerme-Kraft (Duesseldorf) 17, (5) 232-7, May 1965. Ger.

In order to utilize high value fuels, residues of production processes which are not sufficient for the power production needed, other fuels have to be used in addition and compound furnaces become necessary. These type furnaces are available for all sizes of steam generators and varied fuelds can be burned either individually or combined in one combustion chamber. If several combustion chambers are used, the flue gases, after the combustion process, flow combined through the rest of the boiler surface. However, incomplete combustion may result if flues of various characteristics are used. The flue gases have to be controlled and analyzed by chemical or physical methods. For this analysis, a combustion diagram is of great value. The construction of such a diagram is discussed in the following equations: Equation of the enlarged combustion triangle by occurrence of hydrogen in the flue gas. Equation of the enlarged combustion triangle by occurrence of hydrogen in the flue gas. Equation of the enlarged combustion traingle by occurrence of loss of carbon. Equation of the enlarged combustion triangle by simultaneous occurrence of hydrogen in the flue gas and loss of carbon. 0nfluence of carbon loss on air proportion. Mixed (compound) fuels. Mathematical formulas are given for the construction of a combustion traingle.

04939

A. B. Walker

INFORMATION REQUIRED FOR SELECTION OF ELECTROSTATIC AND COMBINATION FLY ASH COLLECTORS; METHODS OF ANALYSIS FOR CHEMICAL PHYSICAL, AND ELECTRICAL PROPERTIES OF FLY ASH (INFORMATIVE REPORT NO. 2). J. Air Pollution Control Assoc. 15, (6) 256-60, June 1965.

The information required for specification or request for bids for fly ash collectors are presented. The APCA Standard Methods for determination of the following properties of fly ash are presented: (1) bulk resistivity of dry particulated in the laboratory; (2) bulk electrical resistivity of dry particulates in situ; (3) water soluble content; (4) water soluble sulfate content (with an alternate method); and (5) loss on ignition.

05302

A. Levy and E. L. Merryman

SO3 FORMATION IN H2S FLAMES. J. Eng. Power 87, (4) 374-8, Oct. 1965. (Presented at the Winter Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 29-Dec. 3, 1964.)

The microstructure of H2S-O2 flames was developed in terms of composition and temperature profiles. With the aid of these profiles, rates of formation of SO2 and SO3 are reported and discussed. With the aid of kinetics and thermodynamic data developed for the principal reaction steps, it is shown that a major part of the SO3-problem may be related to the O-atom oxidation of SO2 in the flame. These fundamental studies of thermochemical reactions provide the basic information needed as the next step in understanding how reactions in flames and on surfaces affect external corrosion and deposits in boiler furnaces. (Author abstract)

07811L

Casey, R. J. and H. J. Falcone

ACOUSTIC FUEL OIL ATOMIZERS FOR NAVAL BOILERS. Naval Ship Engineering Center, Philadelphia, Pa., Project No. B-485, ((17))p., Jan. 18, 1967. DDC: AD 807213L

The use of sonic energy to atomize Navy Special Fuel Oil has been proposed. In light of its application in commercial installations and claims that sonic atomizers reduce excess air and increase combustion efficiency they were incorporated in burners for evaluation in naval boilers. Three different sonic atomizers were utilized. Performance data from forty-five tests was obtained through single burner operation in DLG-6 and DLG-9 test boilers. The feasibility of using sonic energy to atomize Navy Special Fuel Oil was demonstrated. Combustion performance of sonic atomizer burners compares favorably with that of standard return flow burners and it is expected that design modifications will eliminate the furnace carbon deposit problems encountered. (Authors' abstract)

10066

Shaw, J. T. and P. D. Green

OXIDATION OF SULPHUR DIOXIDE IN AIR AT 950 DEG C: CO-OPERATIVE INFLUENCES OF CARBON MONOXIDE AND NITRIC OXIDE. Nature, 211(5054):1171-1172, Sept. 10, 1966. 8 refs.

The oxidation of sulfur compounds in fuel during composition to form sulfur dioxide and the further oxidation of this to sulfur trioxide gives rise to the problem of corrosion, specifically in boilers. The part played by oxides of nitrogen and carbon, both of which occur influe gases from normal fuels, and their influence on the oxidation of sulfur dioxide in a clean system has been investigated. A marked effect on sulfur trioxide production was found when nitric oxide and carbon monoxide were present together. The experiment is described.

12997

Koizumi, Mutsuo, Hirokazu Mizutani, Yoshihiko Takamura, and Katsuya Nagata

HIGH SPACE HEAT RELEASE AND LOW EXCESS AIR COMBUSTION OF HEAVY FUEL OIL USING EXHAUST GAS RECIRCULATION METHOD. Bull. JSME (Japan Soc. Mech. Engrs)., 12(51):530-538, 1969. 8 refs.

The use of low excess air combustion in boilers for the reduction of corrosion of low-temperature heating surfaces results in increased soot formation. Where high-space heat release is used to obtain smaller boiler size, overheating of the combustion chamber walls results. An exhaust gas recirculation method, in which exhaust gases are mixed with combustion air, was applied to heavy fuel oil firing equipment fitted with a pre-combustion chamber in an effort to reduce the inherent problems in low excess air combustion. Combustion was almost completed in the pre-combustion chamber with a heat output of 10,000,000 kcal/cu m/hr and an excess air factor of 1.03. Soot formation was on the order of 70 mg/N cu m, being reduced as exhaust gas recirculation was increased. The acid dewpoint was slightly reduced by exhaust gas recirculation. Gas temperature in the pre-combustion chamber was lowered and eventually became stable with increases in recirculated exhaust gas.

13487

Fukuma, Shin-ichi and Kazumi Kamei

DRY-SYSTEM FLUE GAS DESULPHURIZATION PROCESS (DAP-MN PROCESS) FOR SO2 REMOVAL. Jap. Chem. Quart., 4(3):12-14, July 1968.

The DAP-Mn process for desulfurization of flue gases has the following properties; it removes SO2 efficiently and economically; recovered by products are of marketable quality; the absorbent has long-term operation and can operate reliably with sharp load fluctuations; consumption of absorbent is minimal and SO2 removal is accomplished without a sharp pressure drop; and no major change in the boiler structure is required. After successful laboratory tests in 1963, this desulfurization process which uses manganese oxide and ammonia to make ammonium sulfate from flue gases was tested at a pilot plant in Japan. A semicommerical plant capable of treating gases from a 55 MW power plant has since been constructed and is being test-run in the compound of Chubu's Yokkaichi station. The process occurs three steps: SO2 removal, absorbent regeneration, and by product treatment. Test results indicate a desulfurization rate of 90% at a 1968 cost of $1/ton of fuel oil.

14363

Samuel, T. and M. Heise

THERMOGRAVIMETRIC METHOD FOR THE STUDY OF THE EQUILIBRIA SOLID STATE/GAS AND MELT/GAS IN SULFATE SYSTEMS IMPORTANT IN CORROSION CHEMISTRY. (Thermogravimetrische Methode zur Untersuchung der Gleichgewichte Festkoerper/Gas und Schmelze/Gas in korrosionschemisch wichtigen Sulfatsystemen). Text in German. Werkstoffe Korrosion, 19(10):837-844, Oct. 1968. 21 refs.

Many liquid sulfates are responsible for high-temperature corrosion. The stability of these sulfates depends on the partial pressure of sulfur trioxide. A method for determining the equilibrium partial pressure of SO3 is described. The SO3 concentration was determined by measuring the CO2 concentration developed according to the reaction Na2CO3 plus SO3 yields Na2SO4 plus CO2 by infrared spectrophotometry. The composition of the condensed phase was determined by weighing a small sample of the substance. Thus, the absorption of SO3 could be observed. Weight, IR absorption, and temperature were continuously recorded. The method is fully explained for the system Na2SO4 - SO3. The diagrams of state for the reaction Na2SO4 plus SO3 yields Na2S2O7 were determined. Uncertainties due to residual moisture and undercooling are discussed. These probably explain the large differences between the current results and those quoted in the literature. The system Na2SO4-SO3 has eutectic point at 390.5 C at an SO3 pressure of 2.57 mbar. The melting point of Na2S2O7 is 402 C. The system Na2SO4/H2SO4 has a eutectic point at 380 C and 1.58 mbar SO3. The eutectic point of K2SO4/SO3 is 411.0 C and 0.305 mbar SO3. The melting point of K2S2O7 is 417.5 C. It is concluded that the alkali pyrosulfates do not corrode gas turbines because of their low decomposition temperatures (435 C for sodium melts and 565 C for potassium melts). In boilers, however, they may play a significant role. The influence of water vapor has not yet been fully investigated.

14896

THE COMBUSTION OF SMALL SIZES OF COKE IN A DOMESTIC BOILER. British Coke Research Assoc., Chesterfield, (Derbyshire), Coke Research Rept. 48, 10p., March 1968.

The influence of a reduction in lump size on the combustion of coke singles in a small domestic boiler was studied. The combustion performances of two cokes were examined. In the case of the first coke, narrow grades of small lump sizes ranging from five-eighths to one-eighth of an inch were used. The ignition and high-output stages of combustion were examined. The size of the second coke was modified from that of commercially produced singles to allow 95% (the lower limit) to be progressively reduced from five-eighths to three-eighths to one-fourth of an inch while 5% (the upper limit) was maintained constant. Three further samples were prepared, involving the introduction of varying proportions of breeze into the singles. Each size of the coke was tested dry and with a total moisture content of 10%. During the combustion tests, the fuel loss through the boiler firebars was estimated. Satisfactory combustion using narrow grades of coke was not achieved. The detrimental features included the lack of thermostatic control and severe fuel losses. A drop in the lower size limit of coke singles of 95% greater than three-eighths of an inch, resulted in a prolongation of the time to attain the rated output, even when the coke contained 10% moisture. Further size reduction reduced the maximum output below the normal level required. The addition of up to 25% of breeze to coke singles has no adverse effect on combustion performance, although there was an increase in the time to attain rated output. When the lower size limit of the coke was dropped to one-fourth of an inch by the addition of breeze, there was a relatively small increase in the quantity of material lost on charging. Observations from the limited data obtained when the fuel bed was deashed suggested that there was a slightly greater loss of material from the samples containing a greater proportion of smaller coke.

15615

Jirous, Frantisek

THE EFFECT OF THE ENTHALPY OF THE FLY ASH ON THE ENERGY BALANCE OF A HEATED SURFACE AND ON THE EXHAUST LOSSES. (Der Einfluss der Enthalpie der Flugasche auf die Energiebilanz der Beruehrungsheizflaechen und auf den Abgasverlust). Text in German. Brennstoff-Waerme-Kraft, 21(9):490-2, Sept. 1969. 9 refs.

An error arises in the energy balance by neglecting the enthalpy of the fly ash. This influences the boiler efficiency. The error becomes apparent when the fly ash concentration varies. In reality, the contact heating surfaces are designed with sufficient reserve so that the effects from neglecting the enthalpy of the fly ash do not necessarily become apparent. However, if the fly ash concentration varies considerably, the boiler efficiency might be strongly impaired. A diagram is given for computing the error. A table indicates the enthalpies of flue gases and fly ash, as well as the errors occurring at various flue gas temperatures.

15695

Yoshida, Hiroshi and Yuji Morikawa

AN APPARATUS FOR BLOWING SOOT. (Susu huki sohchi). Text in Japanese. (Mitsubishi Heavy Industries, Ltd., Tokyo (Japan)) Japanese Pat. Sho 44-12322. 2p., June 4, 1969. (Appl. Aug. 20, 1966, claims not given).

The apparatus for blowing soot consists of a tube the length of a hearth which has a row of nozzles parallel to the axis; it is supported in a hole of a bearing board fixed to the hearth wall. The gas media, such as steam or compressed air from the nozzles, blows the soot by turning back and forth through the prescribed length of the hearth. When the nozzles blow toward the front of the hearth, the flow of the gas in the hearth is hindered, thus increasing the pressure in the hearth. If the pressure increase is too great, the hot gas is emitted from the opening. This tendency is more noticeable in smaller hearths, and disturbs the running condition by lowering the efficiency, thus creating a danger for the operator. This inefficiency is corrected by the present invention. Nozzles are arranged in a spiral form, and the tube rotates around the axis. Because the flow of the hot gas is not disturbed, and the effect on the gas flow is always constant, a pressure increase is prevented. Thus, the boiler runs steadily and easily with a high efficiency. To limit the blowing to a certain section, a cover is fixed on the bearing board for that part of the tube. The arrangement makes the use of a complicated apparatus to limit the motion of the tube unnecessary. The nozzles may be placed in several rows.

15799

Smith, Ennis C., Addison Y. Gunter, and Sydney P. Victory, Jr.

FIN TUBE PERFORMANCE. Chem. Eng. Progr., 62(7):57-67, July 1966. 22 refs.

The performance of air-cooled heat exchangers depends on the effectiveness of the fin tube and the air moving equipment; consequently, the following parameters were determined for extruded and tension wound fin tubes: joint contact pressure and isothermal temperature at which the contact pressure is exhausted as manufactured by both mechanical strain gauge and heat transfer tests; fin column stability as determined by visual means, photographically, and by strain gauges; effects of variation in intensity of thermal shock and cycling. The results indicated that isothermal mechanical strain gauge tests are an accurate means of determining isothermal temperature and the average contact pressure. Fin column stability is one of the important limitations of the maximum values obtainable for manufactured contact pressure and isothermal temperature. The average contact pressure obtained directly from strain gauge data was 1100 lbs/sq in. for the extruded fin tubes and 250 lbs/sq in. for the footed tension wound fin tubes at 80 deg F manufactured temperature. Tube liner protection is an important factor. The results were compared with previous recommendations and findings.

15944

Rylands, J. R. and J. R. Jenkinson

THE ACID DEW-POINT. Eng. Boiler House Rev., vol. 69:104-111, 1954. 14 refs. (Presented at a meeting of the Inst. of Fuel, London, March 4, 1954.)

The mechanism of deposit formation on heat-exchange surfaces of sulfuric acid at elevated temperatures is considered in terms of acid dew point temperatures and the reliability of instruments for estimating the acid dew point. Also discussed is the new concept that the rate of condensation of sulfuric acid, as distinct from dew point temperatures, depends on the amount of acid in the gas. To resolve arguments concerning the form in which acid is condensed, acid dew formation was studied by volumetric techniques not dependent on electrical measurements. Tests demonstrated the presence of two distinct dew points: acid and water. Results show that while there may be a theoretical dew point temperature as defined on a saturation basis, there is no precise dew point temperature as defined on a condensation basis: properties of the adsorption layer shaded insensibility into those of the liquid layer of the condensate. Other experiments were directed toward the role of water vapor in the condensation mechanism. They show that water vapor fixes concentrations of the condensate and hence the overlying SO_3 partial pressures. A corresponding rise in acid dew point temperatures indicates that a variation in the water content affects the acid dew point. Maximum acid deposition for most acid concentrations in boiler practice occur at 220 to 280 F. Above this range, acid exists in an unsaturated state; below it, the acid combines with water vapor to form a mist. The supersaturation phemomena can be suppressed by shock cooling gaseous mixtures with lower acid concentrations at a location slightly before the approximate dew point position.

16883

Halstead, W. D. and E. Raask

THE BEHAVIOUR OF SULPHUR AND CHLORINE COMPOUNDS IN PULVERIZED-COAL-FIRED BOILERS. J. Inst. Fuel, 42(344):344-349, Sept. 1969. 14 refs.

Laboratory experiments and probe tests in boilers have been made to study the decomposition of pyrite, the evaporation of sodium chloride and the formation of sulfates in the flue gas of pulverized-coal-fired boilers. The results have been compared with theoretical predictions made on the basis of thermodynamic calculations. In large boilers where there is good mixing of the fuel and combustion air it is shown that the conversion of chloride to sulfate is complete when the flue gas leaves with only trace amounts of chloride. Initial deposits on the furnace tubes will contain significant amounts of chloride and pyrite residues when there is either a localized deficiency in oxygen, or a particularly short residence time of sulfur and chlorine compounds in the flame. (Author's Abstract)

20274

Collins, Conrad G., Jr.

A REVIEW OF SULPHUR FLAME TECHNOLOGY. (PART 2). Sulphur Inst. J., 6(1):18-22, Spring 1970. 52 refs. Part I. Ibid, Winter 1969-70.

The encounter and reaction of sulfur dioxide with an oxygen atom appears to be the predominant mechanism for sulfur trioxide formation according to most studies of stack gases and the hydrogen sulfide flame. The mechanism can be important only in flames with high temperature (1200 C) zones for the formation of atomic oxygen, as at lower temperatures, the slow homogeneous reaction between SO2 and molecular oxygen appears to be a two body collision reaction. Catalytic action of nitric oxide for oxidizing SO2 to SO3 is questioned in lower temperature regions where SO2 would react only with molecular oxygen, but if high temperatures prevail, such that the oxygen atom concentration is appreciable, the catalytic effect of NO may be established. Experimental work with hydrogen chloride added to the flame (nucleophilic partner) yielded 38% SO3, and HCl was viewed as a stabilizing medium for SO3. Different sulfur oxide species have been detected spectroscopically at a variety of conditions, from low temperature to the high temperature of shock waves.

32430

Clark, L. W.

EDDY CURRENT CONTACT ABSORBERS FOR SULFUR DIOXIDE. (Wirbelstrom-Kontaktabsorber fuer Schwefeldioxid). Text in German. Chem. Anlagen Verfahren, no. 7-8:46-47, July-Aug. 1968.

An eddy current contact absorber was developed based on a previously used prototype scrubber that processes flue gas from a coal-fired boiler installation. The sulfur dioxide content of the gas at the scrubber inlet is 0.05 to 0.15% by volume. The effectiveness of the absorption depends on the difference between partial pressure of the gas to be dissolved and its vapor pressure above the absorbing liquid. The partial pressure of SO2 gases in concentrations of 0.05 to 0.15% is about one mm Hg. To maintain an active pressure differential, the vapor pressure above the liquid must, therefore, be near zero. The vapor pressure is a function of the temperature of the absorbing liquid and of the pH value. The pH can be influenced by the use of various alkaline solutions as absorbing liquids. The usual alkali for SO2 absorption are sodium carbonate and potassium carbonate. At minimum concentration, either of these solutions can maintain a pH value of 10 to 12, at which condition the vapor pressure of the SO2 is almost zero, as desired.

G. EFFECTS-HUMAN HEALTH

00236

H. Neuberger

CONDENSATION NUCLEI - THEIR SIGNIFICANCE IN ATMOSPHERIC POLLUTION. Mech. Eng. 70, 221-5, Mar. 1948. (Presented at a Joint Fuels Conference of the American Inst. of Mining and Metallurgical Engineers and The American Society of Mechanical Engineers, Cincinnati, Ohio, Oct. 20-22, 1947.)

Author discusses the constituents of the atmosphere and refers to the suspensions in the atmosphere as 'aerosols'. Explanations of dust and condensation nuclei including their chemical and physical nature are included. Also included is a section on the sources of nuclei as well as biological effects of aerosols. Charts include: Sulphur content of air and average number of nuclei in representative cities; Average ultraviolet radiation and number of condensation nuclei for clear skies; Average number of condensation nuclei per cubic millimeter for clear and cloudy skies; Mean number of condensation nuclei for various ranges of dust concentration in city air; and Retention of condensation nuclei in human respiratory system for various concentrations of nuclei in air.

07541

P. Polu, P. Laurent, C. H. Guyotjeannin, D. Thin

AN OCCUPATIONAL DISEASE OF CHIMNEY SWEEPS CLEANING OIL-FIRED FURNACES. (Pathologie professionnelle des fumistes effectuant le ramonage des chaufferies a mazout.) Text in French. Arch. Maladies Profess. Med. Trav. Securite Social (Paris), 26(4-5):435-446, April-May 1967. 8 refs.

The frequent and consistent symptoms experienced by chimney sweeps cleaning oil-fired furnaces appear to present a new specific syndrome. Most of the efforts of industrial hygienists have been concentrated on the pollution in the air and not much has been done on the chemistry of soots. Findings, hypotheses as well as suggestions for control are presented. A table is given which compares the symptoms of the workers such as irritation of the eyes, the upper respiratory tract, the mouth, and skin as well as serious deterioration of their clothing. The men also complained of loss of appetite, nausea, vomiting, lack of coordination of movements, amnesia, and headache. In the same table in parallel columns are listed the symptoms of exposure to vanadium, sulfur dioxide, and oxides of nitrogen. Based on an examination of the soot involved it was concluded that the vanadium was not involved in the symptoms of the chimney sweeps and that the sulfur content of the fuel was an important factor. It is recommended that fuels low in sulfur be used, that the optimum combustion conditions be maintained by keeping the temperature of the flame down by a high excess of outside air. Electrostatic precipitators can cut the emission of SO3 by 50%. The injection of magnesia in the vicinity of the flame can meutralize the SO3he use of industrial-type vacuum cleaners offers a method of furnace cleaning without an occupational exposure.

11656T

F. F. Lampert

HYGIENIC EVALUATION OF LIVING CONDITIONS IN APARTMENTS ABOVE STATIONARY BOILERS. ((Gigienicheskaya otsenka uslovii prozhivaniya v kvartirakh nad vstroennymi kotel'nymi.)) Translated from Russian. Gigiena i Sanit., No. 7, 1956, p. 14-18.

The air in eleven apartments and one area in a children's home situated above boiler rooms utilizing solid fuel were analyzed for CO and SO2. Eleven other apartments and one room in the children's home located in the same building but in areas away from the boiler rooms served as controls. The air in apartments located above boiler rooms was much more polluted by CO and SO2 than air in the control apartments. The frequency of detection and the concentration increase during cleaning of the boilers indicated that the boiler room was the source of the pollution. In order to study the effect of the air on the carboxyhemoglobin level three groups of persons were examined: 22 janitors, 56 persons who lived above boiler rooms, and 63 children from areas with no stationary boiler room. The tests, adjusted for a 6% COHb level in all city dwellers, showed that children living in buildings with no stationary boiler had a carboxyhemoglobin concentration of less than 6 percent in the overwhelming majority of samples. In persons living above boiler rooms the number of positive samples amounted to 34 percent. Most of the samples with concentrations above 6 percent were found in janitors (64 percent).

H. EFFECTS-PLANTS AND LIVESTOCK

14944

Fukuchi, Tomoyuki and Takeo Yamamoto

A FEW IDEA ON COUNTERMEASURE AS TO BE CONNECTION WITH EXHAUST GAS FROM GAS-WORKS AND DAMAGE ON MANDARIN. (Toshigasu seizokojyo no haigasu to mikan no higai narabini sono taisaku ni kansuru shokosatsu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(9):17-23, Sept. 1969. 22 refs.

Because mandarin oranges fell from trees before the harvest period, waste gas from a gas works near the orange orchard was suspected to be the cause. With this idea as a starting point, the relationship between waste gas and ripening oranges was examined in a laboratory. The possibility that the ripening period had been accelerated by other factors, such as hydrocarbon gases, especially ethylene, was considered. It was reported by Magill that the tomato is influenced by hydrocarbons such as ethylene, 0.1 ppm; acetylene, 50 ppm; propylene, 50 ppm; and butylene, 50,000 ppm. Thus, a very small amount of ethylene has a great influence on ripening fruit. According to the result analysis of the waste gas, the assumption that windblown ethylene influenced the ripening orange is reasonable. The boiler system for waste gas control is shown. By means of chemical reactions, ethylene vanished at 260 C. Gas compounds are first prevented from entering the boiler and are then sent to a reservoir tank and mixed with catalyst and steam, and finally discharged in vapor form. By this treatment, the waste gas compounds are vaporized. Since this boiler system has been used at the gas works, damage to oranges has decreased.

I. EFFECTS-MATERIALS

04622

R. H. Boll and H. C. Patel

THE ROLE OF CHEMICAL THERMODYNAMICS IN ANALYZING GAS-SIDE PROBLEMS IN BOILERS. J. Eng. Power 83, 451-67, 1961. (Presented at the Annual Meeting, American Society of Mechanical Engineers, New York City, Nov. 27-Dec. 2, 1960)

Part 1 deals with equilibrium concentrations of 29 gaseous and 5 condensed constituents which were calculated for the combustion gases from 2 coals. Temperatures ranged from 440 to 3140 F and fuel-air ratios from 90 to 130% of theoretical air. The 2 coals were selected for their difference with respect to behavior in a boiler. Both are high in S but the Pana, which is especially high in alkali and Cl, produces a highly fouling and corrosive deposit, whereas the Wright contains less of these elements and is innocuous with respect to superheater fouling. In determining the elemental composition of the gases, it was assumed in all cases that: (1) 95% of the nonash S appears in the combustion gas, the remainder going into ash; (2) 40% of the Na content of the coal appears in the gas; (3) 20% of the K content of the coal appears in the gas; (4) all of the K content may be handled as though it were Na; and (5) except for Na, K, and S, no ash constituents enter the combustion gas. Results are presented in graphical and tabular form. Starting from the equilibrium-gas composition results of Part 1, the regions of thermodynamic stability of various Na and Fe compounds are obtained in Part 2 as functions of temperature and fuel-air ratio. It is shown that purely thermodynamic considerations impose an upper temperature limit upon corrosion mechanisms involving complex iron sulfates. The severe fouling tendency of high alkali coals is discussed. By purely thermodynamic means, this study has succeeded in approximately separating the regions wherein accelerated oxidation and sulfation can operate as corrosion mechanisms. Results are in good agreement with experimental observations when allowance is made for probale error in certain basic thermodynamic data, for solution effects and for differences in behavior among the different alkali-metal compounds. Sulfidation is predicted thermodynamically if O2 is excluded from the metal surface. Na2SO4 and Na2Si2O5 are stable above 1600F in contact with high-alkali combustion gas.

11286

Frey, Donald J., R. C. Ulmer, O. B. Bucklen, and P. Meikle

BOILER TUBE CORROSION. Preprint, Combustion Engineering, Inc. and West Virginia Univ., Morgantown, 15p., 1966. 6 refs. (Presented at the Annual Meeting, National Coal Association Technical-Sales Conferences and Bituminous Coal Research, Inc., Pittsburgh, Penna., Sept. 14-15, 1966.)

High temperature corrosion of coal boiler superheater and reheater surfaces is an industry wide problem. The ideal solution would be to render the coal product shipped to the utility noncorrosive. The remainder of this report discusses a program aimed largely at eliminating corrosiveness of coal but at the same time alleviating its air polluting tendencies as much as possible. An integral part of this project is the establishment of relative rates of corrosion produced by coals of varying physical and chemical properties. Methods of testing and design of test equipment are discussed. Metal wastage occurs as the result of a chemical reaction between the tube surface and a complex alkaliron-sulfate compound, expressed as (K3 or Na3) Fe (SO4)3. Three ingredients are absolutely necessary; sodium and potassium oxides, iron oxide, and SO3; if any one of these three reactants is missing, corrosion will not occur. Attention is also being given to the alkaline earths, calcium and magnesium, since these are known to play an inhibiting role in the corrosive reaction. It is believed that Ca and Mg, in forms reactive with SO3, tie up a portion of the alkalies as double salts (viz. K2SO4.2CaSO4). As such, the alkalies are unavailable for formation of the corrosive compound. In general, the higher the soluble alkali content, the greater the observed rates of corrosion.

13681

Thomson, A. G.

DEPOSITS ON BOILER PLANT HEATING SURFACES. Eng. Boiler House Rev., vol. 69:269, 1954.

The role played by SO2 and SO3 in the formation of bonded deposits on boiler superheater tubes was investigated under experimental conditions. A mixture of flue gas containing SO2 and radioactive SO3 was passed over sodium chloride at various temperatures. By measuring the activity of the sulfate produced, the percentage of sulfate derived from the SO3 was determined. Corrections to allow for oxygen exchange between the SO2 and the SO3 were made by determining the activity of the exit SO2 and SO3 gases. The amount of sulfate formed at low temperatures was not great, but a considerable amount was formed as the temperature was increased. Above 650 C, most of the sulfur was derived from SO2. The addition of a catalyst resulted in the production of sulfate from SO2 at temperatures as low as 300 C. With SO3, the rate of reaction was unaffected by the catalyst. The evidence that Na2SO4 in boilers is derived largely from SO2 implies that the sulfur content of a fuel is an important consideration in the formation of bonded deposits.

14084

Barrett, R. E.

ALKALI IRON TRISULFATE FORMATION WITHIN DEPOSITS IN AN OIL-FIRED LABORATORY COMBUSTOR. J. Eng. Power, 91(Sect. A, no. 3), July 1969. 14 refs. (Presented at the Winter Annual Meeting of the Am. Soc. Mech. Engrs., New York City, Dec. 1-5, 1968.)

Alkali iron trisulfates (M3Fe(SO4)3) are major contributors to the corrosion of superheater tubes of boiler furnaces, and factors affecting their formation were studied in an oil-fired laboratory combustor which simulated a boiler-furnace environment. To produce the high SO3 concentrations necessary to stabilize trisulfates at superheater temperatures, SO2 was catalytically oxidized to SO3 by three fly ashes containing 17 to 30% Fe2O3, 38 to 40% SiO2, and 17 to 28% Al2O3. Effects of deposit composition, deposit thickness, temperature, and SO3 concentration on formation of trisulfates were examined.

Preheating of the Fe203-Kaolin mixtures at 2000 F for 16 hrs significantly reduced the catalytic activity of the mixtures, indicating that the thermal history of fly ash is more significant than its composition in affecting catalysis. Tests show that trisulfates can form within a few hours and in the absence of thick deposits. Potassium appears to be more reactive than sodium in forming trisulfates, while fused deposits, apparently sodium vanadyl vanadate, form readily when both vanadium and alkalies are present. Formation of these molten vanadium compounds is inhibited by magnesium oxide. Although these results are not conclusive in defining the exact corrosion mechanism, they should prove useful in further studies of the reactions leading to corrosion and deposits.

14153

Weintraub, M., S. Goldberg, and A. A. Orning

A STUDY OF SULFUR REACTIONS IN FURNACE DEPOSITS. J. Eng. Power, vol. 83:444-450, Oct. 1961. 5 refs.

The association of external corrosion of certain heat-transfer surfaces in high-pressure, coal-fired boilers with adherent deposits that are rich in alkali metals and sulfur was investigated. The constituents of these deposits are generally combined as normal sulfates, pyrosulfates, or more complex compounds, such as potassium ferric trisulfate. The sulfates found in the deposits do not occur as such in the coal, and therefore were assumed to result from chemical reactions during combustion or from reactions between combustion products and compounds previously deposited on the metal surfaces. A study was made of absorption of sulfur from synthetic flue gas by coal ash. When fly ash was placed in a temperature gradient like that in a boiler tube, deposit, maximum absorption was found in the coldest layer. When held at constant temperature, maximum absorption was found at 1100 F. The amount of absorption was highest for fly ash from furnaces in which serious deposit formation was observed. It was also highest for fly ash containing the highest content of sodium and potassium. A liquid phase of these compounds in contact with tube metal causes corrosion. The maximum sulfur absorption found at 1100 F coincides with a maximum at the same temperature that has been observed for external tube-metal corrosion. (Author abstract modified)

14948

Yamamoto, A.

PREVENTION MEASURES OF CORROSION OF CHIMNEYS AND FLUES OF HEAVY OIL BURNING BOILERS. (Juyu boira no entotsu oyobi endo no fushoku taisaku). Text in Japanese. Netsu kanri (Heat Management: Energy and Pollution Control), 21(7):19-25, July 1969.

Decrease in weight due to corrosion is greater at the chimney exit than at the entrance with high percentages of excess air. Low-oxygen and low-temperature operation is the key to the prevention of chimney and flue corrosion. Another measure for preventing corrosion is the proper choice of liner materials. Over 50 kinds of metals and non-metals were tested for resistivity to sulfuric acid and high temperature and for mechanical strength. Among gunnite liners, fly ash cement with sand was found to be the best, although its resistivity to acid was limited by the binder. Brick and ceramics were both heat- and sulfuric acid-resistant. For the latter, the higher the density and lesser the void, the better the resistivity. Resin mortar and water glass mortar were the most appropriate as binders. An acid-resistant castable material of the water glass family was excellent in acid resistivity but rather permeable to acid. Plastic liners of fluorine, polyether chloride, or the phenol family proved good, but the latter was most economical. Coatings on gunnite liners were not as effective as those on steel plates. Among metals, lead was the most corrosion- resistant. Steels with high tensile strength were superior to mild steels, but this resistivity varied with composition. An electrical detector of corrosion in liners was developed and proved successful in application to two or three chimneys.

15274

Mauss, M. F.

SULFURIC CORROSION IN HOT WATER HEATERS. (Corrosion sulfurique dans les chaudieres a eau chaude). Text in French. Rev. Ass. Fr. Tech. Petrole, no. 188:127-136, 1968. 19 refs.

This study showed that certain traditional findings on steam boilers have little application in the case of hot water boilers. According to the classic Hoffmann graph, the rate of corrosion has a maximum between the condensation temperatures of water and sulfuric acid from the fumes. In this range, relatively concentrated acid is deposited. Below the water condensation point, dilute acid with SO2 in solution condenses and causes very fast corrosion. In hot water heaters, oxidation of SO2 to SO3 takes place only in the flame and not on the walls. In these studies, fuel oils containing 0.5% and 2% sulfur were used. The rate of corrosion of a sample of soft steel and the rate of formation of an acid film on glass were measured, the latter with the B.C.U.R.A. apparatus. Temperatures of maximum potential corrosion, i.e., considering all deposited SO3 as being transformed into FeSO4, were never found, perhaps because the sulfur content or the rate of fuel consumption was too low. In a 314,000 metric ton (?) per hour furnace, the quantity of sulfur in the gas, before and after passing the heat exchanger, was measured to determine the mass of sulfur deposited. It was shown that water temperature had less influence on the deposition rate of SO3 than the air excess used in the burners, especially below 10% excess air. It is recommended that this be taken into account in the operation and design of water heaters.

17475

Weber, G.

THE INFLUENCE OF SULPHUR CONTENT ON CORROSION. (Der Einfluss des Schwefelgehaltes auf das Korrosionsergebnis). Text in German. Mitt. Ver. Grosskesselbesitzer, 50(1):60-66, Feb. 1970. 6 refs.

Conductance and direct corrosion measurements were taken for two oil-fired steam boilers with capacities of 90 and 100 t/h. The first boiler was fired with a fuel oil containing 0.9% sulfur; the second boiler was fired with fuel oil containing 1.65% sulfur. For corrosion measurements, up to 100 probes cooled with compressed air were inserted into the flue gas duct ahead of the air preheater. The weight loss of each probe and the surface temperature of every tenth probe were measured. The weight loss through operational corrosion was considerable at the plant fired with the higher sulfur fuel. However, to about 100 C (or even 90 C) surface temperature, the weight loss was so low that maintenance of a wall temperature of about 100 C prevented the air preheater from premature wear. Standstill corrosion was about the same in both plants, which means that it is largely independent of the sulfur content. The weight losses were 0.38% of the initial weight/1000h of standstill for the plant fired with the lower sulfur fuel and 0.45% at the second plant.

21641

Nelson, Wharton and E. S. Lisle

A LABORATORY EVALUATION OF CATALYST POISONS FOR REDUCING HIGH- TEMPERATURE GAS-SIDE CORROSION AND ASH BONDING IN COAL-FIRED BOILERS. J. Inst. Fuel, 37(284):378-385, Sept. 1964. 7 refs. (Presented at the 19th Annual Conference of the National Association of Corrosion Engineers, New York City, 1963, p. 2603.)

A laboratory test was used to screen catalyst poisoning ability of additives designed to hinder catalytic production of SO3 and reduce dependent formation of corrosive complex alkali sulfates on finishing superheater and reheater tubes of coal-fired boilers. In this test, the weight gain with time response of alkali-sulfate rich synthetic ash mixtures containing various additives was determined at typical temperatures in flue gas atmosphere. Antimon trioxide was by far the most effective compound tried. Three percent reduced the amount of complex sulfates by 90%, prevented bonding entirely, and decreased corrosion of stainless steel test coupons by 93% in a ten-day test at 1100 F. Its beneficial action was verified as catalyst poisoning by gas analysis for sulfur trioxide in a series of experiments with and without the additive. The poisoning ability of antimony trioxide, which attenuated at temperatures near its melting point, was extended to higher levels by mixing with sorptive siliceous minerals like diatomaceous earth. A synergistic effect found with this combination may make possible the dilution of antimony trioxide with 80 to 90% of cheap sorptive materials without sacrificing efficiency. Some other antimony compounds exhibited catalyst poisoning tendency, possibly due to release of antimony trioxide on heating. (Author abstract modified

23460

Stoenner, A.

INFLUENCE OF REDUCING FLUE GASES ON THE CORROSION OF FURNACE TUBES. (Einfluss von reduzierender Rauchgasatmosphaere auf die Korrosion von Brennkammerrohren). Text in German. Mitt. Ver. Grosskesselbesitzer, 49(3):180-182, June 1969. 3 refs.

The partial renovation of combustion chamber pipes of a forced- through-flow boiler carried out after 55 thousand working hours revealed a very good agreement with the results of the study of combustion processes by measurement of flue gases concentration in the atmosphere of combustion chamber of the boiler 6 years ago. The position of highest carbon monoxide concentrations found at that time coincided with the most corroded areas of the pipes. It was estimated that in the presence of 1.3% sulfur and 3-4% CO in the close neighborhood of the tube wall, the rate of wall thinning was .6 mm 110 to the fourth power hours. The economic aspects of the necessity of partial changing of combustion chamber pipes are considered.

28335

Rosborough, D. F. and W. Hansen

STUDIES OF HIGH-TEMPERATURE CORROSION OF OIL-FIRED BOILERS OF POWER PLANTS WITH NEAR STOICHIOMETRIC COMBUSTION PROCESS. (Intersuchungen ueber Hochtemperaturkorrosionen an oelgefeuerten Kraftwerkskesseln mit nahstoechiometrischer Feuerfuehrung). Text in German. Mitt. Ver. Grosskesselbesitzer, 51(1):51-57, Feb. 1971. 9 refs.

Experiments on high-temperature corrosion were conducted at two power plants. Both boiler furnaces were operated with an air surplus of less than 2%. In one plant, austenitic steel AISI 316, together with two ferritic steels (1% Cr and 8% Cr), were used for pipes; in the other plant, the same austenitic steel and a ferritic steel (12% Cr) were used. The experiments lasted for more than 1000 hours at metal temperatures to 650 C. At metal temperatures corresponding to a steam condition of 565 C, significant high-temperature corrosion occurred. This was particularly true for the second plant where the pipes were exposed to high flue-gas temperatures and a high flame radiation. The ferritic metal alloys proved to be more resistent than the austenites. Corrosion was due primarily to oxidation and sulfide formation, although the oxygen concentration in the flue gas was only 0.1 to 0.2%. It is concluded that near stoichiometric combustion is advantageous with respect to low-temperature corrosion and boiler efficiency. It does not however, prevent high-temperature corrosion in boilers designed for higher steam temperatures.

29783

Rasch, Rudolf

COMPLEX ALKALI IRON SULFATES A CONTRIBUTION TO THE THERMODYNAMICS OF FIRESDIDE HIGH-TEMPERATURE CORROSION. (Komplexe Alkali- Eisen-Sulfate Beitrag zur Thermodynamik der Feuerseitigen Hochtemperaturkorrosionene). Text in German. Chemiker. Ztg. (Heidelberg), 95(9):405-414, 1971. 69 refs.

The present state of high temperatures corrosion research (hydrogen chloride, sulfate, and sulfide corrosion) is surveyed. In the combustion chambers of boiler furnaces and incinerators, incrustation of the heating surfaces is the first step toward corrosion. Corrosive agents in the flue gas and fly dust such as sulfur trioxide, sodium sulfate, HCl, sodium chloride, sulfur dioxide, hydrogen sulfide, and sodium sulfite are the direct or indirect causes of corrosion. Fireside high-temperature corrosion is closely related to the frequent changes between reduction and oxidation. With the aid of thermodynamic equations, the reaction mechanism at the reduction of oxide layers on the heat exchangers could be determined. Moreover, the assumptions concerning the reaction mechanism which causes sulfates to concentrate on the heat exchanger surfaces could be narrowed by thermodynamic calculations. The formation of the intermediate incrustating or wetting layers is to some extent due to the complex alkali-iron sulfates. Solutions of alkali sulfates with iron sulfates occur under the formation of complex compounds, as well as alkali-aluminum-sulfate complexes, sulfates of other heavy metals, and arsenic compounds. External pipe erosions are due to hydrogen chloride corrosion, local erosions are due to sulfide corrosions.

29956

Rogner, Walter

PROBLEMS IN INDUSTRIAL POWER PLANTS. (Probleme des industriellen Energiebetriebes). Text in German. Energie (Munich), 23(4): 119-123, April 1971. 13 refs.

The use of fuel oils containing vanadium leads to corrosion of super heater pipes on the flue-gas side. During combustion, vanadium fractions of the oil reacts with oxygen to form vanadium pentoxide, which is highly corrosive, primarily in its liquid state. On combustion of fuel oils also containing sodium and sulfur fractions, complex oxygen compounds develop with eutectic melting temperatures of 580 C. Although these eutectica are less corrosive than V205, they nevertheless attack heating surfaces. The rate of corrosion depends on the ash composition and the ash quantity, as well as on the type of material. Vanadium-containing material is susceptible to corrosion while steel with a high chromium low nickel content is quite resistant. Fuels with a V203/Na20 ratio of smaller than 0.9 are less corrosive. Combustion of sulfur-containing fuels leads to formation of sulfur dioxide, which upon cooling to less than 700 C reacts with the free oxygen of the flue gases to form SO3, when cooled to below 500 C, SO3 reacts with the water vapor produced by the combustion process to yield sulfuric acid. This condenses on surfaces with temperatures between 80 and 160 C.

30022

Wahnschaffe, E.

A STUDY OF THE CONVERSION OF SO2 TO SO3. (Ein Beitrag zur Umwandlung von SO2 zu SO3). Text in German. Energie (Munich), 23(5):165, May 1971.

Sulfur dioxide and sulfur trioxide, which to some extent are responsible for corrosion problems, develop from the combustion of sulfur-bearing fuels. The reactions of the individual components of the flue gas must be known to determine the factors influencing the conversion of SO2 to SO3. The total nitrogen content in the flue gases is dependent on the boiler load; it increases with increasing load. If the oil is efficiently atomized, thereby improving the addition of primary air, the concentration of nitric oxide is reduced. The development of nitrogen oxides depends on the load, the oxygen content, and the fuel/air mixture; these oxides have considerable influence on the conversion of the sulfur oxides. Their concentration is highly significant in boiler corrosion.

31588

Rasch, R.

FORMATION OF IRON-II-CHLORIDE AND IRON-III-CHLORIDE AT HIGH- TEMPERATURE CORROSION IN FURNACES. Battelle Inform. (Frankfurt am Main), 1969:18-22, 29 refs. NTIS: N70-42557-562

High temperature corrosion, particularly the external tube corrosion occurring in melting chamber boilers and in heat exchangers of refuse incinerators, is initiated by the decomposition of the oxide film protecting the metal. The oxide film is decomposed either by reduction, or because alkali pyrosulfates decompose it with formation of complex alkali-iron sulfates. After the decomposition of the protective oxide film, hydrogen chloride contained in the furnace gases may react with iron-II-oxide, iron carbide, and elemental iron to give volatile iron chlorides. Iron carbide and elemental iron occur only as unstable intermediate phases. At elevated temperatures, the sodium chloride in fossil fuels reacts with sulfur trioxide or with silicic acid and water vapor to form sodium sulfate or sodium silicate. This reaction yields hydrogen chloride, one of the corrosive components in flue gas. The hydrogen chloride present in the flue gases of refuse incinerators is produced by the combustion of polyvinyl chloride. With present-day refuse, which contains an average of one percent by weight of PVC, the concentration of hydrogen chloride in the flue gases of refuse incinerators is between 0.05 and 0.1%. The concentration of hydrogen chloride in the flue gas depends on the composition of the refuse and the air ratio. (Author introduction modified)

J. EFFECTS-ECONOMIC

01308

M.N. Magnus

HISTORY OF FLY ASH COLLECTION AT THE SOUTH CHARLESTON PLANT UNION CARBIDE CORPORATION - CHEMICALS DIVISION. J. Air Pollution Control Assoc., 15(4):149-154, April 1965.

This report summarizes the installation and operation of fly ash collection and disposal equipment at the South Charleston Plant and includes installation costs, replacement costs based on present-day cost factors, as well as performance data, and maintenance and operating costs. (Author abstract)

21241

Fogel, M. E., D. R. Johnston, R. L. Collins, D. A. LeSourd, R. W. Gerstle, and E. L. Hill

COMPREHENSIVE ECONOMIC COST STUDY OF AIR POLLUTION CONTROL COSTS FOR SELECTED INDUSTRIES AND SELECTED REGIONS. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., NAPCA Contract CPA 22-69-79, RTI Proj. OU-455, 414p., Feb. 1970. 360 refs. CFSTI: PB 191054

Costs are estimated for controlling emissions of particulates, sulfur oxides, hydrocarbons, and carbon monoxides from twenty-two sources within 100 metropolitan areas, through the Fiscal period 1970-1975; data defining relevant processes and air pollution control engineering characteristics required to support the analyses are presented. Sources for which control cost estimates were made are solid waste disposal, steam-electric generating plants, industrial boilers, commercial and institutional heating plants, residential heating plants, and the following industrial categories: kraft pulp, iron and steel, gray iron foundry, primary and secondary nonferrous metallurgy, sulfuric acid, phosphate fertilizer, petroleum refining, cement, lime, coal cleaning, petroleum products and storage, grain milling and handling, varnish, and rubber tires. The total investment cost includes $221 million, $1.29 billion, and $1.13 billion to control emissions from solid waste disposal, stationary combustion, and industrial process sources, respectively, while the metropolitan areas for which cost estimates are the highest include the very large, highly industrialized, more northern cities of Chicago, New York, Pittsburgh, Philadelphia, Cleveland, Detroit, and St. Louis. Assuming the 1967 emissions as a baseline, calculations are performed to determine the pollutant removal efficiencies required to bring the emissions into compliance with the standards assumed. (Author abstract modified)

26757

Jackson, Walter E. and Henry C. Wohlers

DETERMINATION OF REGIONAL AIR POLLUTION CONTROL COSTS AND THE COST OF AIR POLLUTION REDUCTION IN THE DELAWARE VALLEY. Drexel Univ., Philadelphia, Pa., Environmental Science and Engineering, U.S.P.H.S Grant AP 00512-01A1, 224p., June 1970. 97 refs.

A procedure is developed for determining costs to reduce air pollution emissions in a metropolitan area. Methods are sufficiently general to be applicable in any region and sufficientl comprehensive to include analysis of all major sources, future trends, control limitations and other factors of importance in a dynamic community. The analytical procedure examines relationships among emission inventories, regional growth, control trends, alternate control schemes, control costs, and optimum cost- effectiveness. The cost analysis procedure is tested by applicatio to the Delaware Valley. Costs are determined for reducing emission to various levels between the years 1960 and 2000. Emissions from private automobiles are projected to decrease below the 1960 emission rate by 1980, at a cost of 150 million dollars per year. Stationary source emissions of sulfur dioxide and particulates can be reduced to 1960 levels by 1980 for 37 million dollars per year if 'least cost' procedures are used (selective abatement). Uniform conversion to 0.5% sulfur fuel oil (equiproportional ababement) can affect a similar reduction in emissions for about 94 million dollars per year in 1980. Other cost analysis comparisons are made and projections to the year 2000 are included. (Author abstract)

30122

Hollander, Herbert I.

VALUE ANALYSIS OF COAL. Combustion, 41(10):13-17, April 1970. (Presented at the Purdue Industrial Coal Conference, Oct. 8, 1969.)

Guidelines are presented which will enable spreader stoker-fired boiler plants to select the most economical and suitable fuels. The guidelines concern the following factors judged to influence utilization by such plants of the available BTU in coals: moisture, coal fines, ash quantity, ash characteristics (ash fusion temperature, iron oxide), sulfur, and heating value. Use of the guidelines to determine relative cost/million BTU is illustrated by graphs and a Relative Coal Utilization Analysis Sheet (showing chemical analysis of the coal and ash and the percentage of particulates passing through screens).

30696

LeSourd, D. A., M. E. Fogel, A. R. Schleicher, T. E. Bingham, R. W. Gerstle, E. L. Hill, and F. A. Ayer

COMPREHENSIVE STUDY OF SPECIFIED AIR POLLUTION SOURCES TO ASSESS THE ECONOMIC EFFECTS OF AIR QUALITY STANDARDS. VOL. I. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., APCO Contract CPA 70-60, RTI Proj. OU-534, Rept. FR-OU-534, 395p., Dec. 1970. 328 refs. NTIS: PB 197647

Air pollution control costs for mobile sources are presented on a national basis and in terms of unit investment and annual operating and maintenance costs as well as total annual operating and maintenance costs. The analyses cover the estimated emissions and control costs for new cars for Fiscal Year 1967 through Fiscal Year 1976. Control costs for each stationary source, except for residential heating, are shown for 298 metropolitan areas by investment and annual expenditures by Fiscal Year 1976. The impact of control on selected industries and the Nation are also determined. Finally, an extensive bibliography is included. The pollutants from mobile sources selected for analysis are hydrocarbons, carbon monoxide, nitrogen oxides and particulates. The six pollutants for which control cost estimates are made for stationary sources are particulates, sulfur oxides, carbon monoxide, hydrocarbons, fluorides, and lead. Emission standards applied are considered stringent in comparison with many currently in use throughout the Nation. Mobile sources include automobiles and light and heavy-duty trucks. Stationary sources studied include solid waste disposal, commercial and institutional heating plants, industrial boilers, residential heating plants, steam- electric power plants, asphalt batching, brick and tile, coal cleaning, cement, elemental phosphorus, grain handling and milling (animal feed), gray iron, iron and steel, kraft (sulfate) pulp, lime, petroleum products and storage, petroleum refineries, phosphate fertilizer, primary non-ferrous metallurgy (aluminum, copper, lead and zinc), rubber (tires), secondary non-ferrous metallurgy, sulfuric acid, and varnish. Data essential for defining metropolitan areas, emission control standards, and relevant process and air pollution control engineering characteristics required to support the cost analyses for each source and the cost impact on each industrial process are presented and analyzed in separate appendixes to this report. (Author abstract modified)

33530

Nordrhein-Westfalen Arbeits- und Sozialminister (West Germany)

IMMISSION AND EMISSION CONTROL. (Ueberwachung der Immissionen und Emissionen). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen. Essen, West Germany, Brinck and Co. KG, 1969, p. 53-65.

Since 1962, particulate emissions are measured over a total area of 6225 sq km by one measuring station per sq km on 4150 sq km and one measuring station for each 4 sq km on 2075 sq km. Sulfur dioxide emissions are measured on 5026 sq km by one station for each sq km. Particulates are measured (continuously) by the Bergerhoff device, SO2 by the silica gel method. A comparison of monitoring results from 1963 and 1967/8 reveals that in almost all areas both SO2 and particulate emissions were reduced. The areas in which maximal emission limit were exceeded since the measuring program began dropped for particulates from 365 sq km in 1964/65 to 234 in 1967/8 and for SO2 from 248 sq km in 1964/5 to 43 sq km in 1967/8. In 12 cities a continuous SO2 monitoring service is in operation which issues smog alerts. The state emission protection law grants the authorities the right to order emission measurements performed by a polluter at his cost. This right is being applied in cases of newly constructed enterprises and following expansions of established enterprises, mainly for SO2 and particulates but also for other pollutants where the situation demands. Since 1966 emissions from steam and hot water boilers are supervised on a systematic basis, and, where maximal emission levels are exceeded, the polluters are prosecuted. All oil-fired central heating systems are periodically tested by district chimney sweeps by the Bacharach method and fines are levied for violations. Heating plants in all local and state government buildings are being also tested regularly.

K. STANDARDS AND CRITERIA

06778

(INDUSTRY AND ATMOSPHERIC POLLUTION IN GREAT BRITAIN.) Industrie et pollution atmospherique en Grande Bretagne. Centre Interprofessionnel Technique d'Etudes de la Pollution Atmospherique, Paris, France. (1967.) 6 pp. Fr. (Rept. No. CI 310.) (C.I.T.E.P.A. Document No. 24.)

A summary of the basis of governmental action in Great Britain in the struggle against industrial emissions is outlined. The regulations imposed by the 'Alkali Act' are in most cases based on 'the most practical means.' Standards are given for chimney heights. Statutory limits are given for various materials emitted such as hydrochloric acid, sulfuric acid, nitric acid, hydrogen sulfide, chlorine, arsenic, antimony, cadmium, and lead. The construction of tall buildings tends to reduce the benefits obtained by tall chimneys. A better knowledge of the effects of pollutants should be obtained so as not to burden industry with unnecessary expense in their control. It is urged that international standards for emission be adopted.

09921

Ministry of Housing and Local Government, Great Britain. 27p. 1967.

REPORT OF THE WORKING PARTY ON GRIT AND DUST EMISSIONS.

The working party on grit and dust emissions was set up to advise the Minister of Housing and Local Government on grit and dust emissions from industrial and other similar furnaces. Ways and means of measuring grit and dust emissions and the levels of emission admissible in relation to furnaces burning fuel equivalent to 100 to 50,000 pounds per hr. of coal are presented. Sampling methods and emission levels are given for the following furnaces; solid fuel fired boilers, oil fired boilers and indirect and heating furnaces.

21896

American Society of Mechanical Engineers, New York, Air Pollution Standards Committee

ASME STANDARD APS-2. RECOMMENDED GUIDE FOR THE CONTROL OF EMISSION OF OXIDES OF SULFUR. COMBUSTION FOR INDIRECT HEAT EXCHANGERS. 11p., Jan. 1970. 14 refs.

The three basic methods for controlling pollution of the air by waste materials are reduction in production of pollutants, collection of pollutants, and dispersion of the pollutants in ambient air by air motion. Control usually involves a combination of two or more of these. The philosophy was adopted that the maximum concentration of sulfur dioxide in the ambient air resulting from discharges is of primary importance when regulating ambient air quality. A method is presented for estimating the concentration of SO2 in ambient air based on the stack height, total heat input, and sulfur content of the effluent. An alternate method involving the allocation of emissions among several stacks of equal height is included. The limitations of these systems caused by the presence of large numbers of low level SO2 sources and topographical conditions are considered. Data presented are arbitrarily cut off at 10,000 million Btu/hr on the theory that very large sources will have to take additional factors into account. Abatement is, of necessity, concentrated on effluent control, since the desulfurization of solid fuels has limited potential and desulfurization of liquid fuels requires extensive and costly additions to existing installations. Flue gas desulfurization techniques under development are limited to large installations because of cost and space and may themselves introduce serious problems of disposal of low strength sulfuric acid and/or large quantities of dust.

25134

Persson, Goran A.

SWEDISH EMISSION LIMITS FOR SPECIFIC SOURCES OF AIR POLLUTION. Preprint, International Union of Air Pollution Prevention Associations, 29p., 1970. 9 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper AD-17D.)

The 'best practicable means' and 'air resource management' approaches to air pollution control are discussed with reference to a 5-yr control program in Sweden worked out by the National Environment Protection Board. The definition and supervision of Swedish emission standards are discussed. These standards are applicable to all operating conditions and should be fulfilled during the entire life of the plant. This means that control equipment must be dimensioned for emissions that are considerably lower than the numerical value of the standard. Generally, the equipment will also have to be divided into two independent units to avoid excessive emissions when one unit is out of operation. Emission standards are given for iron and steel, ferroalloy, gray iron foundry, cement and lime, asphalt, pulp, chemical, solid waste disposal, and fuel combustion. Standards are adopted for both new and existing units. For the latter, the requirements should be met before July 1, 1974; government subsidies will cover 25% of the investment costs. The degree of control to meet the standards and investment and annual costs are evaluated. The permissible contributions to ground-level concentrations of sulfur dioxide and particulates used in calculating stack heights are given. Tall stacks are used as complements to but not as substitutes for efficient air pollution control at stationary sources. (Author abstract modified)

31968

Yamamoto, Norimasa

ON EMISSION STANDARD OF SMOKE (HARMFUL SUBSTANCES) BASED ON AIR POLLUTION CONTROL LAW. (Taiki osen boshiho ni motozuku baien -- yugai busshitsu -- no haishutsu kijin ni tsuite). Text in Japanese. Preprint, Smaller Enterprises Promotion Corp. (Japan) 72p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Characteristics of smoke, dust collection equipment, average particulate diameter, and other factors are tabulated. The number of boilers in Tokyo, Osaka, and Kanagawa are compared. The emission standard for dust is 0.06 g/N cu m-0.20 g/N cu m for boilers and furnaces, in newly constructed installations, which utilize heavy oil as fuel. The average cadmium concentration at nine monitoring stations in 1969 was 0.020 micrograms/cu m. Environmental pollution due to heavy metals is also considered. At 0.1 ppm, the odor of chlorine can be detected with slight irritation; at three to six ppm, there is irritation of the eyes, nose, throat, and headache, while life is threatened at 14-21 ppm. Chlorine also damages plants after about 0.5 ppm. Chlorine, up to 0.5 ppm, is contained in tap water. The environmental standard should be less than 0.02 ppm. Even small amounts of fluorine in the atmosphere can damage plants, and the standard should be two to five micrograms/cu m. Above two to eight ppm of F, teeth have motley patterns, and eight to 15 mg/day for 10 years would bring about softening of the bone. Standards are also given for sulfur dioxide, carbon monoxide, oxidants, hydrocarbons, and nitrogen dioxide. Air pollution control agencies, districts, plans and alerts are mentioned.

34015

AIR POLLUTION CONTROL LAW. (Taiki osen boshi-ho ni tsuite). Text in Japanese. Preprint, Japan Industrial Newspaper Co., Tokyo, 10p, 1971. (Presented at the Seminar on Air Pollution Control, Tokyo, Japan, Sept. 1971.)

The present Air Pollution Control Law, issued in 1968, is based on the Laws concerning stack gas emission of 1962. Main points of revision are reviewed, and newly added pollutants, emission regulations, emission standards, fuel standards, particulate standards, automotive exhaust gas emission standards, emergency operations, treatment of stack gases from electric and gas factories, enforcement of laws, and progress reports are discussed. Localized emission standards of sulfur dioxide are: 0.020 ppm for the Tokyo-Yokohama area, Osaka-Amagasaki, Yokkaichi, and a few cities were newly added. Maximum permissible concentration is 0.022 ppm for Kashima, Chiba, Ichihara, Kurashiki, and few other cities of Akita and Shizuoka prefectures; 0.024 ppm for Muroran, Fuji, Nagoya, Himeji, Wakayama, northern Kyushu areas, and some parts of Hokkaido; and 0.027 ppm for Sapporo, Kawaguchi, Hatogatani, Kyoto, and some cities of Shikoku and eastern provinces. The largest maximum permissible concentration of SO2 is 0.045 ppm and this applies to all areas mentioned above and other areas where designated indexes are 0.030 to 0.040 ppm. Stack gas emission standards according to the new regulation are 0.05 to 0.10 g/N cu m for boilers using heavy oil and 0.20 to 0.40 g/N cu m for boilers using coal. Furnace emission standards are 0.05 to 0.10; rotary, roasting, sintering, and open hearth furnaces are 0.20 to 0.30; other heating, smelting, drying, cement, electric furnaces are 0.20 to 0.40; and incinerators are 0.20 to 0.70 g/N cu m. Special emission standard areas and toxic material emission standards are given.

34154

British Standards Inst., London (England)

RECOMMENDATIONS FOR THE CONSTRUCTION OF SIMPLE SMOKE VIEWERS. Brit. Standard, no. 2741, 12p., 1969. 1 ref.

Two types of smoke viewers are described. In the first, a light is viewed through the flue gases and the appearance of the light itself is taken as an indication of the density of the smoke. This type is normally used in brick-set boilers. In the second type of viewer, a beam of light passes through the smoke onto an opalescent screen, the brightness of which gives an indication of the smoke density. This viewer may be used in most other boilers. The windows of the viewers are liable to damage by grit particles during soot blowing, making it necessary to protect them while the soot blowers are in operation. Cleaning should be carried out manually at least once per shift, and always after soot blowing. Diagrams of the viewers are given.

L. LEGAL AND ADMINISTRATIVE

04620

R. C. Huxford

UTILIZATION OF SOLID FUEL TODAY. J. Inst. Heating Ventilating Engrs. (London) 32, 405-33, Feb. 1965.

Types, classification and preparation of coal, different methods of delivery and conveyance, mechanical stoking and ash removal are considered; different types of boiler and fuels applicable to each are reviewed; use of solid fuel in relation to British Clean Air Act is considered and various coals classified.

04942

F. B. Kaylor

AIR POLLUTION ABATEMENT PROGRAM OF A CHEMICAL PROCESSING INDUSTRY J. Air Pollution Control Assoc. 15, (2) 65-7, Feb. 1965.

Solvay Process, a Division of Allied Chemical Corporation, utilizes Onondaga County's only two mineral resources, salt and limestone, to manufacture soda ash as well as caustic soda, chlorine, calcium chloride and chlorinated organics. The following areas involved most of the major pollution complaints: particulate matter from the boiler house, dust and fumes from the lime kilns, smoke and soot from the ammonia-caustic soda concentration operation, smoke and soot from soda ash calcining operation, and occasional situations where odors and reactions of sulfur dioxide were noticeable. The abatement program and its costs are described.

06741

E. S. Monroe, Jr.

RECENT COMBUSTION DEVELOPMENTS PREVENT AIR POLLUTION - LOW EXCESS AIR FIRING OF HEAVY FUEL OILS AND NEW WASTE INCINERATOR. 90th Congress 'Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. pp. 2597-2601. (Presented at the Joint Technical Conference on Clean Air, Trenton, N.J., Nov. 19, 1964.)

The advantages of stoichiometric combustion or low excess air firing of heavy fuel oils are discussed. A new incinerator for the destruction of waste products is described which utilizes a simplified overfire airjet system. Both of these systems excel in performance and economy and their rapid adoption appears to be to the mutual advantage of industry and the public.

07202

Tada, H.

THE REGULATIONS FOR SMOKE ABATEMENT. Text in Japanese. Kuki Seijo (Clean Air, J. Japan. Air Cleaning Assoc.) (Tokyo), 4(1):1-5, 1966.

The law of smoke abatement was first adopted by the Japanese government in 1960. Prior to that time only local authorities adopted such measures. The regulations are directed against smoke from factories (including the area, facilities, and materials used) and other types of exhaust. The facilities which fall under the regulation are boilers (electric, heat-producing, and those using sulfur-containing fuels), furnaces (calcinating, gas exhausting, sintering, revolving, open hearth), and incinerators. Under the regulation, 'smoke' includes soot, cinders, powdery dust (such as cement dust and iron dust), SO2 gases, and others. The maximum permissible concentration of smoke is tabulated according to facility, ranging from 0.5 to 2.0 g/cu m at OC and 1 atmos pressure. A smog signal or alert must be issued when the concentration os SO2 in the air is greater than 0.2 ppm for 3 hr or 0.3 ppm for 2 hr. The system of control and direction is outlined.

07363

Fournier, M. and P. Jacquinot

FIGHT AGAINST ATMOSPHERIC POLLUTION FROM DOMESTIC FURNACES. CONTROL MEASURES IN EFFECT IN THE SPECIAL PROTECTION ZONES IN PARIS DURING WINTER OF 1965-1966. ((Lutte Contre la Pollution Atmospherique Due aux Foyers Domestiques. Controle Exerce dans les Zones de Protection Speciale a Paris (Hiver 1965-1966.)) Text in French. Pollut. Atmos. (Paris), 9(34):91-99, Apr.-June 1967.

The activities under the jurisdiction of the Housing Department of the Seine District in their fight against air pollution for the winter of 1965-1966 are outlined. The philosophy of the control efforts to end pollution from domestic heaters is based on proper management of the fire, with the quality of the combustion adapted to the quality of the fuel. The large volume of data taken as the result of tests and during various insepctions is presented in charts. Inspections of 476 boiler rooms using coal and 327 using fuel oil showed 13 of the coal burners and 38 of the oil burners did not comply with present regulations. The causes of the defective installations included use of improper fuels, poor regulation of the draft, and failture to clean chimneys and flues. The establishemnt of special zones of protection against atmospheric pollution is too recent to draw any conclusions as to their effectiveness. The equipment in these areas is not being used to the best advantage as far as the control of emission of colored smokes. The authorities are moving from a period of education and testing to an enforcement phase where cooperation is not received.

07550

Philadelphia Dept. of Public Health, Pa.

AIR POLLUTION FROM FUEL COMBUSTION PROCESSES IN PHILADELPHIA. Preprint, 8p., Sept. 1966.

The combustion of fuels is the greatest single source of air pollutant emissions within a metropolitan area. As much as 80% of the total weight of pollutants discharged to the atmosphere result from the burning of fuels for electrical power generation, for industrial and commercial heat and power, for domestic heating, and for vehicular power. The purpose of this report is to summarize the present status of the problem in Philadelphia and to recommend necessary regulations and other action required to deal with the problem.

07950

F. G. Sugden

LOCAL AUTHORITY PROBLEMS IN AN INDUSTRIAL AREA. Roy. Soc. Health J. (London), 87(4):204-214, July-Aug. 1967. 5 refs.

The history of air pollution control in Britain under The Alkali b8works Act of 1863, the Public Health Act of 1875, and the Clean Air Act of 1956 is presented along with a review of current problems in the measurement and control of air pollution which confront local authorities in industrial areas. Until 1946, the standard deposit gage was commonly used for measureing air pollution. Some of the instruments had been in use sincethe 1920's. Since the Second World War, air filters which permit daily readings of smoke and sulfur dioxide have been used although deposit gages continued in use. The use of deposit gages was unfortunate since local authorities did not measure the trend in grit and dust deposition which are an important part of total air pollution. Results should be studied on the basis of 3,4 or 5-year moving averages to level out meteorological variations in any one year. Smoke from industrial sources seems to come primarily from steam raising plants and the control of dark smoke is delegated to the local authorities. Suggestions are made for changes in the Clean Air Act to require more information in regard to new installations. The burning of material in the open should be brought under the dark smoke regulations. The most prolific grit producer subject to local control i s the cold blast cupola. In 1963, more than 1/2 the arresters fitted to the larger cupolas were the dry type and 18% had no arresters. The amount of SO2 in the air will increase unless there is an increase in the use of low sulfur fuels. The ground level control of SO2 is based on proper chimney heights. Since domestic smoke is responsible for much of the smoke pollution, further diminution depends on increased implementation of smoke control orders. In spite of past accomplishments, much remains to be done.

09445

Comprehensive Planning Bureau, Japan, Osaka Municipal Office

AIR OVER OSAKA CITY. 93P., 1967

The location, geographical features, population, manufacturing, and administration of Osaka City are discussed. An extensive discussion of the measurement of air pollution is presented. The sampling networks and measurement of dustfall, sulfur dioxide, suspended particulate matter, automobile exhaust gases, and meteorological parameters are discussed in detail. A survey of air pollution sources in Osaka City is summarized.

09603

Maryland State Dept. of Health, Baltimore

43P04 REGULATIONS GOVERNING THE CONTROL OF AIR POLLUTION IN AREA III. Preprint, 6p., March 29, 1968.

A regulation governing area III in the State of Maryland specifies: the control and prohibition of open burning; and maximum allowable emissions of particulate matter from fuel burning equipment. Area III is comprised of the Baltimore Metropolitan Area, and the counties of Anne Arundel, Baltimore, Hartford, and Howard.

09604

Maryland State Dept. of Health, Baltimore

43P05 REGULATIONS GOVERNING THE CONTROL OF AIR POLLUTION IN AREA IV. Preprint, 10p., March 29, 1968.

A regulation governing area IV in the State of Maryland specifies the control and prohibition of: visible emissions; particulate matter from fuel burning equipment, incinerators, other installations, material handling; gas, vapor and odor emissions; and open burning. No control equipment that may produce emissions can be operated such that a nuisance is created. Area IV is comprised of Montgomery and Prince George Counties.

09677

Public Health Service, Washington, D. C., National Center for Air Pollution Control

A COMPILATION OF SELECTED AIR POLLUTION EMISSION CONTROL REGULATIONS AND ORDINANCES. (REVISED EDITION.) 142p., 1968.

This compilation contains selected sections of many emission con- trol regulations and ordinaces. It has been prepared to provide state and local air pollution control agencies, industries, and other interested people with selected examples of the many types of regulations and ordinances in use today. All sections of regula- tions and ordinances included have been copied directly from the original text of individual state and local laws. The regula- tions and ordinaces have been arranged in such a manner that each section of this report is a compialtion of laws pertaining to a specific type of pollutant or pollutant source. These sections include Smoke Emissions and Equivalent Opacity Regulations, Particulate Emissions from Fuel Burning Plants, Particulate Emissions from Refuse-burning equipment, Particulate Emissions from Manufacturing Processes, Particulate Emissions from Asphalt Batching Plants, Sulfur Compound Emissions, Organic Solvent Emissions, Hydrocarbon Emissions, Fluoride Emissions, Motor Vehicle Emissions, Odor Emissions, and Zoning Ordinances. The regulations and ordinances compiled were selected to represent the different methods of controlling emissions by law and to represent varying degrees of control.

11077

Loquercio, Peter A. and William J. Murphy

HOW AN EFFECTIVE PERMIT SYSTEM WORKS. Preprint, Dept. of Air Pollution Control, Chicago, Ill., Engineering Services Div., ((24))p., ((1968)). (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-111.)

The controversial subject of the relative merits of a Permit System in the field of air pollution control is discussed. Details are given describing how a successful permit system in Chicago is being routinely applied for registering and regulating all air pollution sources. Furthermore, the unique method of intergrating this system with other Municipal Bureau activities, such as Zoning, Ventilation, Fire Prevention, etc. is explained. The Permit System not only has the capability of very effectively recording air pollution sources but also has the benefit of making available a cross reference from these other Bureaus. This provides another facility by which unregistered air pollution sources are located. (Authors' abstract, modified)

16343

CONTROL OF AIR POLLUTION. Intern. Digest Health Legislation, 20(3):499-512, 1969. (Original text in Public General Acts and Measures of 1968, Chapt. 62, p. 1523-1538, 1969.)

The British anti-air pollution act is presented in its entirety in addition to supplements, schedules, and means of administration. Various terms are defined. Limits on the rates of emission are prescribed. The uses of furnaces are standardized, and the over-all policy of the act is provided. The emissions covered include dark smoke, grit, dust, and fumes.

16736

Cleary, Graham J.

A STATUS REPORT: AIR POLLUTION CONTROL IN AUSTRALIA. J. Air Pollution Control Assoc., 19(7):490-496, July 1969. 13 refs.

All but one of the Australian States now have legislation to control air pollution. These are similar in broad principle and rely upon the system of prior approval and the use of emission limits. At the present time Victoria is the only state with legislation providing for the recycling of crankcase vent gases on motor cars. Methods being used to control pollution and future outlook and needs are discussed. At least 65 percent of the crude oil requirements should be met by indigencus low sulfur oil by 1975. This fact and the imminent supply of natural gas to the four major cities and to the centers of heavy industrial development should result in a marked reduction in sulfur dioxide concentrations. A major outstanding problem is the lack of air pollution considerations in planning at regional and local government levels. (Author's Abstract)

20698

Dickinson, R.

MEASUREMENTS OF DOMESTIC SMOKE EMISSION AND THEIR APPLICATION TO CLEAN AIR LEGISLATION. J. Inst. Fuel, vol. 43:75-81, March 1970. 15 refs.

To assist in the implementation of a clean air policy, a laboratory investigation was conducted to determine the weight of smoke emitted from domestic solid fuels and appliances. A small electrostatic precipitator was used to determine the weight. A representative range of open-fire fuels including bituminous coals, low volatile steam coals, anthracite, manufactured fuels, and wood and peat fuels were compared by a standard series of tests. Supplementary investigations were made to find the effects of the method of ignition, size grading, and refuelling procedure. Measurements were also made of the emissions from two authorized fuels on a small boiler and from a limited number of experimental smoke-reducing appliances. These investigations have enabled the British Standards Institution to draw up a standard for the authorization of manufactured smokeless fuels and to recommend the exemption of smoke-reducing appliances and to recommend these to the Ministry of Housing and Local Government. It was recommended that the authorization level should ensure a smoke reduction of 80% compared with bituminous coal; a limiting level of 0.9% at a burning rate of 2 lb/hr was considered appropriate.

20861

Henderson, J. S.

PLANNING FOR AIR POLLUTION CONTROL. PART 1- LAWS AND THEIR IMPACT. Plant Eng., 24(12):94-97, June 11, 1970.

The Clean Air Act of 1967 designates 91 air quality control regions and makes each state responsible for adopting regional air quality standards and for developing an abatement procedure plan. The central cities of the air quality control regions are specified in this article, and the need of control agencies to include emission standards in their implementation plan is discussed. Typical standards for particulate emissions from coal-fired boilers, manufacturing processes, and incineration are summarized, as are representative ambient air standards for particulates and sulfur dioxide. Some state and local laws require all emission sources to meet both pollution emission and plume visibility standards. Plant engineers may also face compliance with other types of requirements and restrictions. These may include industrial source registration, including quantities and location of pollutant discharges; registration of plant expansions or process changes; plant access and inspection by control authorities; provision of stack sampling ports and platforms, and continuous monitoring of stack discharges.

21104

Japanese Ministry of Health and Welfare, Tokyo

AIR POLLUTION CONTROL LAW (1968). (AMBIENT AIR QUALITY STANDARDS FOR SULPHUR OXIDE.) EMISSION STANDARD). P. L. 97, 50p., June 10 1968.

Regulations are presented to control sulfur oxide emissions in soot and smoke from industrial and vehicle exhaust sources. The Minsters of International Trade and Industry and of Health are empowered to established emission standards applicable to individual 'designated areas.' After a 2-year compliance period, violators are subject to fines and, in some cases, imprisonment; in additions, operations of the emitting facilities are temporarily suspended. Provisions are made for cases of accidents or emergency situations. The Minister of Transportation provides the allowable limit for vehicle exhaust emissions. An expert mediation panel is established to adjudicate civil cases resulting from damages caused by pollution. An enforcement order issued by the Cabinet on Nov. 30, 1968 includes a list of specified noxious substances, and set 0.2 ppm as the highest hourly value for atmospheric sulfur oxides permissible during a year, or 0.06 ppm in the annual average of hourly values. Size or capacity of specified types of boilers and furnaces are enumerated. Supplementary orders include a formula for calculating standard limits for sulfur oxide discharge, exhaust limits for combustion equipment, limits for carbon monoxide from vehicles, environmental quality standards of sulfur oxides for public health, 5- and 10-year goals for environmental improvement, research objectives, calculation of stack heights, and various policy and enforcement decisions and amendments.

23610

Public Nuisance Control Committee (Japan)

BASIC POLICY REGARDING THE ESTABLISHMENT OF A PUBLIC NUISANCE CONTROL PROGRAM FOR THE TOKYO AREA. (Tokyochiiki ni kakawaru kogaiboshikeikaku sakutei no kihonhoshin. An). Text in Japanese. Yosui to Haisui (J. Water Waste), 12(9):750-758, Sept. 1, 1970.

A control program to be effective throughout the Tokyo metropolitan area other than islands in the Pacific Ocean under the jurisdiction of the metropolitan government is presented. The area is a megalopolis with 11.5 million people, and the industrial and economic activities are increasingly exacerbating the pollution problem. Air pollution from automobiles and factories is severe. It originates from the central and Joto areas as well as from factories along the Arakawa River and Sumida River. Water pollutio in Sumida, Naka, and Tama Rivers is also intense. The pollution levels are to be lowered to within the tabulated limits by 1980. The necessary control measures are numerous, but the following are especially emphasized in view of the national planning priorities. They are the control measures against stationary air pollution sources, purification of sea water in the coastal areas and fresh water in rivers and streams, control of nuisances accompanying automobile traffic, control of ground settling (in some areas as deep as four meters), and treatment measures for metropolitan and industrial wastes. In addition, the establishment of nuisance monitoring and measurement system is necessary, and close cooperation with the neighboring prefectures is indispensable. Detailed tables are given on the target maximum allowable concentrations of sulfur oxides, suspended particulates, and carbon monoxide in air as well as cyanides, alkyl mercury, organic phosphorus, cadmium, lead, chromium, arsenic, mercury in general and pH, BOD, SS, DO, and coliform bacteria values for water pollution. The maximum allowable noise levels for daytime, morning and nighttime are also listed.

24828

Cox, Geoffrey E.

BOILERS AND THE CLEAN AIR ACTS. J. Inst. Heating Ventilating Engrs. (London), vol. 38:A24, A29, A30, Oct. 1970. (Also: Oil Gas Firing, June 1970.)

Legislation of The Clean Air Acts 1956/68 involves the design, installation and usage of boilers, and responsibility rests on the Manufacturer, the Installer, the Retailer of both fuel and appliance, and of course the User. The User is prohibited from emitting dark smoke, and a comparison is provided between the Ringlemann Chart and the Bacherach and Shell smoke test given at the boiler fluehood. New furnaces should be capable of operatin continuously without emitting smoke as far as practicable. There are prescribed limits on the user for emission of grit, dust and fumes. However, the MEG and UEG range of solid fuel boilers are exempted on the basis that they fall within the stated category of combustion chamber and stoker design, in that the burning rate is not more than 25 lbs of fuel per sq ft of combustion area per hour and below the maximum input rating of 1 ton per hour. The installer must make notification and have the Local Authority's approval of chimney height. Obligations of the manufacturer, installer, and user are summarized. Smoke control areas will be set up where purchase of prescribed solid fuel as wel as appliances are the responsibility of both user and retailer.

26938

West Virginia Air Pollution Control Commission

REGULATION II--TO PREVENT AND CONTROL AIR POLLUTION FROM COMBUSTION OF FUEL IN INDIRECT HEAT EXCHANGERS. West Virginia Administrativ Regulations, Chapt. 16, Article 20, Ser. 2, 10p., 1966.

A regional air quality control area is initiated along the Kanawha River (Charleston area), and establishes smoke control within it. Definitions are provided for 'new' equipment and 'existing' equipment. Ringelmann No. 1 is the smoke limit for new equipment, and Ringelmann No. 2 is the limit for existing equipment with equivalent readings on approved opacity meters being accepted in lieu of Ringelmann readings. Fly-ash limitations are based on a sliding scale as a function of the heat input of the system. Larger systems are more limited than are smaller systems. The smoke regulating sections include provisions for 8-min in every eight hours of up to a number 3 Ringelmann rating to allow for start-up of a new fire or soot blowing. Owners of existing equipment that cannot meet the requirements of the regulation may avoid being in violation by submitting a modernization plan to the Air Pollution Control Commission for approval and, following approval, complying with its schedules. Penalties for violation are established by the Air Pollution Control Law and may only be imposed by the courts. Maximum penalty under the law is $1000/day of violation. Residential and small apartment house (6 units max) heating systems are exempted from this regulation. Registration, testing, fuel use reporting, and notice of intent to modify equipment or change ownership thereof are provided for in the regulation.

27242

Henderson, J. S.

AIR POLLUTION CONTROL: LAWS AND THEIR IMPACT. Text. Ind. (Atlanta), 135(2):54-58, Feb. 1971. 7 refs.

The Federal Air Quality Act of 1967 is discussed, as well as state and local air pollution standards. The Act charges the Department of Health, Education and Welfare with three new activities: the designation of air quality control regions, the publication of ambient air quality criteria, and the publication of air pollution abatement techniques. A list of air quality control regions is presented. Under the Act and after regional designation each state is responsible for adopting regional air quality standards and for developing an abatement implementation plan. A flow diagram for action to control air pollution on a regional basis is included. Source emission standards, plume visibility standards, and ambient air quality standards are mentioned. Limiting particulate emissions and sulfur dioxide is indicated. The Ringelmann Chart is cited for determinations of plume density.

30779

REVISED REGULATION FOR ENVIRONMENTAL CONTROL, TOKYO. (Tokyoto kogai boshi jorei no shiko kisoku ckaisei). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(3):61-63, March 1971.

A revised regulation initiated in Tokyo standardized the sulfur content in oil used by factories according to their total oil consumption. The installation of smoke and dust collectors for boilers, furnaces, incinerators, and of an anti-steam device against hydrocarbon gas was ordered. Factories were requested to reduce their discharge of sulfur dioxide by 30% to 70% at the time of smog warnings. The owners of automobiles were advised to install afterburners at authorized garages. Copper, zinc, oil, COD (chemical oxygen demand), appearance, odor, and temperature were added to the previous list of 11 water pollutants subjected to the maximum discharge law. Factories along the Tama, Edo, and Naka Rivers will receive a warning as soon as the water content reaches a certain point. Vibration and durt were newly designated as subject to noise- control0 laws. Seventeen items were newly designated as industrial wastes, including alkali and acid wastes, metal dust, and sludge. Factories were requested to report periodically concerning the classification, quantity, and method of disposal of various wastes, and to appoint qualified pollution controllers for each category of environmental pollution.

31509

Cheaney, Edgar S., Richard E. Barrett, Richard B. Engdahl, Joseph A. Hoess, David W. Locklin, Philip R. Sticksel, and Albert E. Weller

APPROACH TO THE COMBUSTION R AND D PLAN. In: The Federal R and D Plan for Air-Pollution Control by Combustion-Process Modification. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., APCO Contract CPA 22-69-147, Rept. APTD-0643, p. II-1 to II-24, Jan. 11, 1971. NTIS: PB 198066

In a planning study that is concerned with the identification and selection of research investments, the resulting research and development plan is intimately related to the valuation and decision-making process used in developing the plan. The planning rationale is discussed for the five-year combustion and research development plan, which is aimed at the control of pollutant emissions from stationary and vehicular combustion sources. An additional factor important to the development of the five-year combustion R and D plan is the projection of pollutant emissions that serves to define the problem which the R and D plan is designed to attack.

31740

Battelle Memorial Inst., Columbis, Ohio, Columbus Labs.

SUMMARY OF THE 5-YEAR COMBUSTION R AND D PLAN. In: The Federal R and D Plan for Air Pollution Control by Process Modification. APCO Contract CPA 22-69-147, Rept. APTD-0643, p. IX-1 to IX-16, Jan. 11, 1971. NTIS: PB 198066

Several aspects of the five-year combustion research and development plan, which is directed to the control of pollutant emissions from stationary and vehicular combustion sources, are considered in order to provide a proper perspective for its utilization. These include the limitations of scope of the plan, its organization and problems of allocating resources, the presentation of competing research opportunities, and the provision of adding new R and D on new concepts not now identified or for accelerating on-going R and D.

32647

Hoess, Joseph A. and Edgar S. Cheaney

PRIORITY RATING METHODOLOGY FOR APPLIED-R AND D OPPORTUNITIES. In: The Federal R and D Plan for Air Pollution Control by Process Modification. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., APCO Contract CPA 22-69-147, Rept. APTD-0643, p. A-1 to A-10, Jan. 11, 1971. NTIS: PB 198066

The methodology used to establish priorities for the applied research and development opportunities in the five-year R and D plan for reduction of emissions from energy-conversion combustion sources by combustion process modification is outlined. Priorities were assigned on the basis of relative potential for air-pollution reduction, relative cost to implement the results of research, and expert judgment. Combustion sources including coal-fired power plants, steam generation, gasoline engines, diesel engines, natural-gas engines, industrial processing, commercial and residential heating, gas turbines, oil, coal, and gas and their combustion products are noted.

32884

Smaller Enterprises Promotion Corp. (Japan)

AMENDMENT DRAFT AND EXPLANATION OF AIR POLLUTION CONTROL LAW ENFORCEMENT REGULATIONS. (Taiki osen boshiho sekorei no kaiseian oyobi kaisetsu). Text in Japanese. Preprint, 20p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Air pollution control laws and amendments in Japan are examined. Regions are divided into eight classes based on the discharge standard of sulfur dioxide, for which the maximum allowable concentration is 0.020-0.045 ppm at groung level. Industries discharging smoke, cadmium, or lead and boilers burning heavy oils must be equipped with electric dust collectors, bag filters, or multi-cyclones. In certain areas, buildings with central heating must install multi-cyclones or more efficient dust collectors or change to gas or electric heating. The prefectural governments may adopt emission standards stricter than those enforced by the national government. Industries discharging chlorine or fluorine must be equipped with alkali washing devices. Sulfur content in fuels is limited to 1.0-1.5%.

33228

Locklin, David W., Albert E. Weller, and Richard E. Barrett

EXECUTIVE SUMMARY. In: The Federal R and D Plan for Air-Pollution Control by Combustion-Process Modification. Final Report. Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., APCO Contract CPA 22-69-147, Rept. APTD-0643, p. I-1 to I-15, Jan. 11, 1971. NTIS: PB 198066

The five year combustion research and development plan recommended in this report is directed to the control of pollutant emissions from stationary and vehicular combustion sources through modification of combustion processes, rather than emission control by add-on or downstream devices. The plan is confined to combustion research and development, both fundamental and applied, for energy-conversion systems utilizing prime fuels and air. Organization, philosophy, and a brief summary of the plan are presented.

M. SOCIAL ASPECTS

08698

Nelson, Bryce

AIR POLLUTION: THE 'FEDS' MOVE TO ABATE IDAHO PULP MILL STENCH. Science, 157(3792):1018-1021, Sept. 1, 1967.

A major inversion occurred in 1959; one resident recalls it as 'the black night.' After such incidents, more citizens protested, and the mayor of Lewiston created a committee on air pollution. In Nov. 1960, the mayor of Clarkston wrote to the chief of the Division of Air Pollution of PHS to request help in abating an interstate air-pollution problem said to be principally caused by the PFI mill. In response to this request, the PHS initiated several meetings with local and state authorities and began a study of air pollution in 1961-62. The PHS study indicated that Lewiston and Clarkston had a common air mass and that either city could pollute the air of the other. The PHS report stated that 50 percent of the physicians in Lewiston and Clarkston had been interviewed and that a large majority of the physicians stated that they concurred in their patients' belief that certain of their disease conditions were related to air pollution and that several noted improvement in patients with respiratory conditions when the patients moved from the area of high pollution or used air conditioning. Included in the PHS-study was an opinion survey conducted in 1962 about community perception of air quality in Clarkston. Nearly 80 percent of those interviewed said that their city was affected by air pollution, and almost two-thirds stated they were bothered by it to some degree. More than 90 percent who recognized air pollution as a problem first mentioned the pulp mill as being among the sources of such pollution. In March of this year, a conference on the areas air pollution was held in Clarkston. The conference provided many area citizens with an unparalleled opportunity to voice their frustration about the condition of their local atmosphere.

N. GENERAL

03197

DIVISION OF AIR POLLUTION CONTRO6 (IN: PENNSYLVANIA DEPARTMENT OF HEALTH 1964 ANNUAL REPORT). Pennsylvania State Dept. of Health, Harrisburg 86-8, 1964

Soot and flyash from boilers, and smoke and odors from open burning at dumps and industrial and commercial sites, accounted for more than 45% of 284 air pollution complaints registered with the Department during the year. Sulfur dioxide gas from coal refuse disposal piles, coal dusts, and dust from limestone quarries and cement plants were other major causes of complaint. The Division conducted sampling programs in the Wyoming Valley, Carlisle, the Lehigh Valley, Greater Johnstown, and the Lock Haven-Williamsport area as part of area air quality surveys. Additional sampling was conducted in Johnstown, as part of an air pollution meteorology research project, and in the vicinity of a number of industrial plants creating air pollution problems. In the course of conducting the air quality surveys and the research project, engineers obtained over 27,000 samples of pollutants. Most of the samples were collected by continuously operated sampling equipment. Ten stack tests were conducted; two autometers, measuring community levels of sulfur dioxide, were operated for a total of 659 days. Wind speed and direction instruments were operated for 827 days. An air pollution meteorology research project was conducted in Greater Johnstown where three telescoping towers were erected to hold instruments used to measure and record data on weather and air pollution. Weather data will be correlated with pollution data to determine which weather factors contribute to the buildup of air pollutants in the community. The Air Pollution Commission continued its study of state-wide regulations to control the emission of smoke, dust, and gases. These proposed regulations will be the first to require that pollutants be controlled to specific levels measured at the source. The seven Regional Air Pollution Control Associations continued to play important roles in the abatement of pollution problems. Most of the 130 abatements recorded during the year were accomplished while the problems were in the hands of the Regional Associations. These Associations attempt to resolve problems on the local level through conciliation and persuasion.

05221

Sinoski, D. A., and W. L. Creighton

ELECTRIC HEAT SUPPLIES DISTRICT STEAM. Power, 110(11):84-87. Nov. 1966. (Presented at the 80th Annual Meeting, Engineering Inst. of Canada, Winnepeg, Manitoba, May 25-27, 1966.)

Steam is supplied to a complex of civic buildings in Toronto by the Toronto Hydro-Electric system. The electric steam generating plant went into service in 1963. The heating load consumes up to 50,000 lb of steam per hour. High-voltage electric boilers generate steam, using off-peak power. Steam, stored in a bank of accumulators, maintains flow for up to four hours during the peak loading times, when the boilers are shut off. Overall capital cost of this installation was approximately $675,000, of which $130,000 was for accumulators. The installed steam generating capacity is 120,000 lb per hr so that the capitalized generating cost is about $4.50 per lb. This cost is comparable to conventional oil-fired installations. Some other major cost items were, approximately: boilers, $160,000; building, $130,000; mechanical work, $80,000, and controls, $45,000.

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